SUPPLEMENT TO THE 40th ANNUAL REPORT MARINE AND FISHERIES

REPORT

ON

BRITISH AND CONTINENTAL PORTS,

WITH A VIEW TO

THE DEVELOPMENT OF THE PORT OF MONTREAL

AND

CANADIAN TRANSPORTATION

BY

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Hon. L. P. BRODEUR, K.C., M.P.,
Minister of Marine and Fisheries,
Dominion of Canada.

DEAR SIR,—In view of the rapid increase of Canadian trade, the future promise of still greater development, and the limited facilities now existing in the Port of Montreal to handle even present Canadian business, your Commissioners have deemed it advisable that immediate steps be taken to prepare a well-defined scheme of development for the Port of Montreal that would ensure retention of Canadian business through Canadian channels.

Having secured your concurrence in these views, the Commissioners resolved that a careful and comprehensive study of British and Continental ports be undertaken previous to the consideration of any development proposal in connection with Montreal harbour.

The report herewith submitted, therefore, gives, besides a study of ports generally, the results of a careful inspection of the following important British and Continental harbours, and some conclusions regarding the situation of Montreal and the River St. Lawrence:—

London,
Liverpool,
Glasgow,
Bristol,
Manchester,
Newcastle-on-Tyne,
Cardiff,
Hamburg,
Antwerp,
Havre,
Marseille.

The information given and the conclusions to be drawn may be of some value in the development of Canadian transportation, the Port of Montreal and the St. Lawrence route.

Yours faithfully,

G. W. STEPHENS.
F. W. COWIE.

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Sir W. G. Armstrong, Whitworth & Co., Limited, Newcastle.

Sir Nathaniel Dunlop, Glasgow.

Sir William Thomas Lewis, Cardiff.

James Hurman, Superintendent, Cardiff Dock Company.

Lord Mayor, Ed. James, of Bristol.

Sidney Humphries, President, Chamber of Commerce, Bristol.

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The Clyde Trustees, Glasgow.
T. R. Mackenzie, general manager and secretary, Glasgow.
W. M. Alston, chief engineer, Glasgow.
Walter Brown, managing director, Wm. Simons & Co., Limited, Glasgow.
Vickers, Sons and Martin, Limited, Barrow-in-Furness.
Stothert & Pitt, Limited, Bath.
The Mersey Dock and Harbour Board, Liverpool.
Robt. Gladstone, chairman, Liverpool.
Miles Kirk Burton, general manager and secretary, Liverpool.
A. G. Lyster, chief engineer, Liverpool.
Mr. Dow, Clerk of Works Committee, Liverpool.
Wm. Watson, chairman, Cunard Steamship Company, Liverpool.
J. H. Beazley, director, Cunard Steamship Company, Liverpool.
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F. A. Eyre, secretary, Manchester.
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R. Joyson, assistant traffic superintendent, Manchester.

FOREWORD.

The comparative study of modern port development in Europe is naturally an intensely interesting one. It presents, however, so many different problems and so much material for investigation that, from the beginning, its besetting and almost insurmountable difficulty has been to reduce to simple parts the mass of information coming from all sources. The method adopted has been to put each port into the same crucible and apply to it the same test, so that the information gained should be simultaneously accurate and comparative.

The fact that during the last twenty years the great world ports have been concentrating their attention on terminal development, that during the same period main lines of railway have been multiplied, tentacle feeders thereto have been pushed into every trade centre giving promise of increased traffic, waterways diverted, new canal systems constructed, all leading from innumerable trade centres to some inland or ocean terminal, makes the problem of increased terminal facilities, perhaps, the most complex as well as the most vital of modern transportation questions.

The object, therefore, of visiting the different sea ports in Europe and Great Britain has been:—

To personally inspect the different phases of port development and management.

To inquire into the special conditions bringing about special results in different cases.

To obtain accurate information with regard to the channel approaches to the different ports.

The method of keeping these channels clear and free of obstruction for navigation purposes.

To examine the different systems of port changes imposed, and the methods adopted for raising revenue and capital.

To study the causes which lead to the investment of such vast sums in the development of modern European ports.

To examine the organization and administrative methods in vogue.

To gather together such reliable information touching upon all these matters as might serve a useful porpose in the development of Canada's national ports.

Transportation, from a Canadian standpoint, would seem to be the most vital problem now requiring attention, for may it not be said that upon its development and efficiency depend the future prestige of Canadian commerce and the integrity of the nation. This fact was recognized by the statesmen who planned and carried to completion the Canadian canal system, linking, by way of the St. Lawrence River, the Great Lakes to the sea; by the few courageous men who developed and completed the Canadian Pacific Railway; and again by those associated with the construction of the Canadian Northern and Grand Trunk Pacific systems.

Within the next few years Canada will have three transcontinental railway lines from ocean to ocean within her own territory. The Canadian canal system has provided, from the Great Lakes to the head of ocean navigation at Montreal, a waterway unequalled on the North American continent, giving a constant canal and river depth of 14 feet. The competing water route from the Great Lakes to the sea, by way of the Erie Canal in the United States, is only 6 feet deep, and the American canal system is 345 miles long as against 72 miles for the Cana-

dian. This means that you can carry an unbroken cargo of 80,000 bushels by the Canadian canal, whereas the extreme cargo limit of the American system is 8,000 bushels. From Montreal to the sea, by way of the St. Lawrence ship channel, Canadian enterprise has established a channel with an available depth of 30 feet now actually in use by steamships of 12,000 tons. By 1910 the channel will be available to Montreal for steamships of 18,000 tons. This gives to Canada a seaport at Montreal, the head of ocean navigation, 1,000 miles from the sea, the junction point of three transcontinental railways, and a canal system with deep water access to Prescott, Kingston, Toronto, Hamilton, Port Dalhousie, Port Colborne, Amherstburg, Windsor, Sarnia, Port Huron, Goderich, Southampton, Wiarton, Owen Sound, Meaford, Collingwood, Midland, Depot Harbour, Victoria Harbour, Parry Sound, Sault Ste. Marie, Fort William, Port Arthur, Duluth, Superior, Chicago, Milwaukee, Bay City, Detroit, Toledo, Cleveland, Buffalo, Oswego, and Ogdensburg. There is no seaport on the North American continent with deep water communication to important trade centres such as this.

The advantage of possessing a canal system which makes possible a continuous waterway within Canadian territory from the Great Lakes to the sea, for vessels of larger tonnage than any other inland waterway in North America, has not yet been fully appreciated by Canadians, nor have the opportunities offered by it been fully availed of. This national highway of trade is the property of the Canadian people and should not be allowed to come under the control of any navigating corporation or railway, or combination of either, as has been the case in the United States where the railways have killed the efficiency of the Erie canal by blocking legislation for its enlargement, in England where the inland waterways have largely been bought up by the railroads and their usefulness confiscated, or in France where a like situation exists with reference to the Port of Marseille.

Hamburg, with a canal system of 8 feet in depth, distributes annually to inland points 8,000,000 tons of freight by the cheapest known means of transportation.

Antwerp, with a canal and river system of the same depth, carries waterborne cargoes to the boundaries of Austria at the rate of something like 6,000,000 tons per annum, and distributes annually by means of her own waterways 37,000,000 tons of merchandise.

Montreal has behind her a canal and river system 14 feet deep, tapping the trade of almost a whole continent. Equip in a proper manner her ocean and lake terminals and no force can divert from the cheapest and shortest trade route the business she ought to command.

At the present rate of increase Canada will, during the 20th century, contribute to the empire a population exceeding that now occupying the British Isles, and if she only cultivates one quarter of her available wheat areas she will produce annually 800,000,000 bushels of grain.

There are only two methods of handling this new business:—

1. By increasing terminal facilities on Canadian soil.
2. By allowing business to be taken care of through American ports.

It would, therefore, seem to be a national duty to equip Canadian sea terminals in keeping with the railway and commercial growth of the country, in order to preserve the national prestige of handling Canadian business through Canadian seaports. With a view of facilitating this important work, the following pages are respectfully submitted as the result of three months' careful study of development work in the great European ports.

SESSIONAL PAPER No. 21c

A STUDY OF PORTS.

I.—Introduction.

In its usual interpretation the term "port" includes roadsteads, entrance channels, harbours, docks, as well as terminal accommodation and equipment for the exchange of products and merchandise between conveyance by water and that by land.

On the other hand, the term "harbour" may signify but a place of shelter for shipping without any particular development.

A "dock" is an interior basin and has been defined as an "artificial repository for shipping."

A port may be upon the open sea, inland at the head of deep water navigation, may be approachable from the interior by water and rail, may be a transit point for the interchange of through business, or may through its immediate markets require development for the purpose of handling large quantities of local freight. Demands may be made upon it to handle all kinds and descriptions of cargo, and at the same time take care of a large passenger business. Added to all these is the important development of local river traffic, both in passengers and in freight.

The problem of port development, therefore, necessitates as a preliminary step the study of actual local conditions; and upon the conclusions arrived at, after such study, the broad lines of its development may be firmly and courageously laid down.

II.—Ocean Business.

(*a*) *Passengers and Mails.*—For this service costly ships, fast trains, first-class hotel accommodation at the terminals, direct route from business centre to centre, and harbours of sure and easy approach are required. Being at once the most costly and most remunerative part of ocean service, special care must be taken in the working out of its development so as to provide from beginning to end efficiency in all departments. Ports for this class of business are selected at points on the open sea, as near as possible to the centres of business; or in special cases, where nature has so planned it, the sea voyage may begin many hundreds of miles from the ocean, at at Montreal.

(*b*) *Freight.*—The chief consideration in the handling of freight cargoes is an economic port fitted with freight handling devices that will enable a given quantity of freight to be handled within the least possible time, large storage areas for the collection of this freight as near as possible to the ship's side, with direct railway or inland water communication to the centres of production and consumption.

(*c*) *Passengers, Mails, and Freight.*—The ideal port, therefore, is one that will attract by its comfort, regularity and safety a paying passenger business, combined with certain regular cargoes made possible by situation, efficient port management, and equipment.

In order to meet these requirements, good channel approaches are necessary, comfortable ships of large tonnage, and intermediate ports of call with rapid transfer appliances for mails. In the interest of a growing country it would appear that the best service would be that of a combined passenger, mail and freight, together with cheap bulk freight transportation for special staples.

The growth and popularity of this transoceanic business depends very largely upon the degree of intimate commercial and traffic arrangements possible between the railways of one country, the railways of another country, and the steamship service linking the two together.

In considering the cost of water transportation as compared with that of land, the following general rule has been given: that it will cost as much to carry 50 tons by vehicle at 500 tons by railway, or 5,000 tons by ocean steamship. It will be seen therefore, that a 20 knot ship (equal to nearly 23 miles an hour) is not very far behind the usual train service as regards passengers and much in advance of train service as regards freight; that ships will make as far inland towards the centre of business as the water approaches and port facilities will admit; that the country possessing a waterway penetrating from the ocean inland for many hundreds of miles to a well equipped ocean terminal possesses an initial advantage of rare value and importance.

Antwerp, Hamburg, and London are European examples of this type, and Montreal is the only port of similar character in North America.

III.—Features of Success.

The existence or success of a port to a large degree depends on the following:—

(*a*) *Early Development.*—Many ports owe their existence to the early development of their locality. Trade is hard to remove from existing channels, and when once removed is even harder to regain. Failure for a few years of public spirit, detrimental legislation, bad administration or war may result in loss of trade prestige and the consequent success of competing ports.

(*b*) *Ownership and Control of the entire Harbour Area.*—No complete development can take place without unity of purpose and concentration of authority. The value of complete ownership and the non-alienation of any territory or rights are inestimable. The existence of rights, franchises or privileges in the hands of individuals may hamper business and endanger or discourage further extension.

(*c*) *Situation.*—To be successful a port should first be on the line of a trade route, should be locally supported by a population behind it and the manufacturers in its neighbourhood. Sentiment plays a most important part in the choice and development of a port.

Safety of approach and non-delay being assured, it may be conceded that the most suitable position for the transfer of goods between water and land is the point farthest inland where ocean and inland traffic may be interchanged. The facility of approach by railway and inland waterways are also of the utmost importance, as well as suitable and convenient areas for terminals, warehouses and the adjuncts of shipping. When there can be found a point possessing all these features a rare and unusually endowed centre for port development and business has been secured.

Countries possessing high tariffs may develop a free port district where transfer, storage, subdivision, re-manufacture, preparation for local markets, delivery in quantities as required, warehousing, without Customs charges, may take place. This is a wonderful factor in the development of a port, as instanced in the port of Hamburg.

Ships may enter a free port, discharge or transfer their cargoes to smaller boats, without the interference of the Customs authorities. Ships' repairs of an extensive nature are done here, consuming home-produced material without Customs restriction of any kind. When delivery is made of the goods stored in a free port district to interior home points, duty is paid at the point of destination, the goods being shipped in bond. This gives the consignee the privilege of bulk storage and shipment in lots to suit his requirements, while he only pays the duty when delivery is made. Where cargo is reshipped to foreign ports out of the free port district no duty at all is paid, but the benefit of storage in large

quantities, re-manufacture or assemblage has been enjoyed. In both cases business has been facilitated and encouraged and wages paid at home.

A special feature to be learned from the successful British and continental ports is the revival of public spirit that has made possible tremendous port development. One cannot visit the great sea towns of Britain and the Continent without being convinced that no great public development of a country's trade outlets can be hoped for without public spirit, determination and sacrifice on the part of the people, and energy and concentration of purpose on the part of the port authorities.

IV.—Types of Port Business.

Five distinct types of port business are specially prominent in the ports visited.

(*a*) *Ocean Ship to Coasting Ship.*—From different parts of the world cargoes arrive in large ships, are sorted and re-shipped in smaller coasting ships to foreign or local ports. Requirements for this trade are commercial centres, convenient points of delivery, minimum Customs charges and restrictive regulations, large storage and warehousing facilities, equipment for cheap handling. Liverpool, London and Hamburg are prominent examples of this kind of business.

The free port district of Hamburg possesses all the advantages of British free trade as goods can be stored, mixed, improved or re-manufactured, together with local raw materials, within these limits, and re-shipped to foreign ports without paying any duty, or to domestic ports in bond.

(*b*) *Ocean Ship to Railways direct and vice versâ.*—This is now an almost universal practice in modern ports. The convenient interchange between the ship and the railway is a great factor toward success or otherwise. The requirements for this business are extensive quay accommodation, tracks to the ship and shed side, large track and terminal areas, control of terminal railways by the port authority.

(*c*) *Ocean Ship to Warehouse by Vehicle, and vice versâ.*—Business of this type is most marked in Liverpool, Antwerp and Montreal. The necessary requirements for its development are convenient and good roads to warehouses, facilities for loading and unloading convenient to the ship, concentration of business and the proximity of large warehouse accommodation, with railway access to and from terminals and warehouses.

(*d*) *Ocean Ship to and from Warehouse by Lighters.*—Special examples of this type are London, Hamburg and Antwerp, where numerous warehouses are accessible from the water direct. Delivery by lighters of from 50 to 200 tons capacity is the cheapest mode of transfer.

(*e*) *Ocean Ship to and from Canal Barges.*—The best examples of this are Antwerp, Hamburg and Montreal, where inland canal systems meet the ocean traffic, with the advantage to Montreal in the depth of the Canadian canal system, which, as compared with either that of Hamburg or Antwerp, has double the capacity and reaches a vastly greater area. On the other hand, Antwerp and Hamburg have the advantage of dense population along the lines of their interior water communication. As transportation by barge is exceedingly cheap, it is one of the most valuable assets of a port.

These five types of business—

(*a*) Ocean ship to coasting ship;
(*b*) Ocean ship to railway direct;
(*c*) Ocean ship to warehouse by vehicle;
(*d*) Ocean ship to warehouse by lighter;
(*e*) Ocean ship to canal barge;

} and *vice versâ*.

are not all of them typical of any one port, but are distributed and may be seen in operation at

Liverpool	(*a*) (*b*) (*c*).
London	(*a*) (*b*) (*d*).
Antwerp	(*b*) (*c*) (*e*).
Hamburg	(*a*) (*b*) (*d*) (*e*).
Montreal	(*b*) (*c*) (*e*).

Montreal having splendid possibilities of developing (*a*) and (*d*): (*a*) by way of the 14 feet Canadian canal system to the head of the Great Lakes through which ships equal to European coasting and Baltic Sea ships can navigate, and (*d*) by her natural suitability for the establishment of a free port area completely approachable by water.

The development of a free port district within the harbour of Montreal is worth earnest consideration, as it would unquestionably make her the great *entrepot* and distributing centre for a large share of North American business. The advantages afforded by a modern and well-equipped manufacturing and bonded warehouse district for the re-manufacture of articles using partial home raw material and labour, and for the storage of through traffic, cannot be underestimated.

V.—Port Types.

River Jetties or Pier Docks.—North American harbours are generally of this type. Harbours of this type in the United Kingdom are rare. Antwerp has extensive riverside quays, but at the same time is developing and constructing wet docks.

The only important example of a wet dock on the North American continent is at Quebec, Canada.

The tidal range in North America varies from a few feet at Galveston, Texas, to 30 feet at St. John, New Brunswick. In all North American ports the accommodation for ships is by means of piers or jetties built along the water front protected from the sea either naturally or by means of artificial breakwaters.

In most cases the piers are built out from the shallow foreshores, but most frequently jetties or riverside quays are constructed along and parallel to the water front, as at New Orleans, Montreal and the Great Lake harbours.

Wet Docks.—Basins artificially enclosed, where the water is maintained at a nearly constant level, and frequently by a combination with one another, forming large systems of safe convenient shelter for all classes of vessels, are called wet docks.

In some of the older ports, such as London, Liverpool and Bristol, the dock development gives a complete record of the size and tonnage of the ships of the periods, from the 200-ton barque of 1708 to the mammoth liner of 1908.

A wet dock, considered great in its time, was opened about two centuries ago at the site of the present Greenland Dock in London. It had a lock entrance 44 feet wide and 150 feet long and a depth at "good spring tides" of 17 feet.

Until the beginning of the 19th century there were only four or five of these docks in existence. From that time to the present, docks of this character have been the rule in Great Britain, and the new undertakings have barely kept pace with the shipping.

Tidal Basins.—These basins are of the same character as wet docks, except that the water rises and falls with the tide. Probably the most notable example of this character is Hamburg.

Of these three types, and the advantages of each, a marked difference of opinion prevails.

When a port is situated on a non-tidal river, railway access to the water front convenient and possible, jetties and riverside quays are the least expensive.

Wet docks are designed to give a safe berth for ships, drift ice is avoided, and a supposed great security from fire exists. As the whole dock area is usually enclosed, immunity from pilferage is secured to vessels and cargoes. This system lends itself to warehouse development on a large scale.

The level of the water in the wet docks is usually maintained at or near high water spring tides, the only water admitted being that to replace the amount let out by the lockages. This is of very great advantage where the tidal water carries sediment, which in some river estuaries is as much as an eighth to a quarter of an inch of deposit per tide. If let into the slack water basin this would create an enormous amount of constant dredging. Currents through narrow entrances due to the storage water rushing in and out with the rise and fall of the tide are avoided.

The quay walls can as a rule be built in the dry, the bottom puddled to make it watertight, and everything completed before the water is let in. The height of the walls do not require to be as high, as it is not necessary to make depth for low tide.

In the River Thames, for example, riverside quays would appear to be an advantage. The water front, however, is owned privately. Warehouses are built to the boundary line, which is near high-water mark, and rights, either real or assumed, permit lighters using the edges of these warehouses as quays, where they ground at low tide. Furthermore, railway access would be practically impossible.

Where the River Thames widens out 22 miles below London Bridge to three-quarters of a mile in width, there is still no general system of riverside quays. Here the Tilbury Dock system has been developed where vessels can only enter or depart at or near high tide; the tides here, as well as the currents, being very similar to those at Quebec:—

Springs	17½ feet.
Neaps	14 "

At Antwerp, which occupies one side of the River Scheldt, as a port, river-side quays were the rule for many years. There are now miles of undeveloped water front, with cheap land, just opposite the present river quays. This land, however, happens to be outside the province of Antwerp, and in order to keep the business on their own side of the river the whole of the new harbour development of Antwerp has been definitely decided upon as a wet dock development.

Hamburg, 76 miles from the sea, on the River Elbe, is an example of a tidal basin development. The tide rises and falls at will throughout the whole harbour. There are no lock entrances, but sliding gates at one or two points in the system prevent the river from running through the different basins. The land is all level and soft, lending itself to this system, the city being intersected by canals from the large basins to the free harbour.

VI.—Dry Docks.

It may be said that no port of the fifth class in Great Britain or the Continent is without its dry or floating dock.

London	30	Havre	6
Liverpool	21	Marseille	6
Cardiff	13	Glasgow	5
Hamburg	12	Bristol	4
Newcastle	11	Avonmouth	2
Antwerp	6	Manchester	
Montreal	None.		

They have developed with the shipping, and it is not usual to enlarge existing docks to meet the increased size of ship. New ones are built, the small vessels using the older ones.

Docks are considered absolutely necessary adjuncts of a port.

The efficiency of dry or floating docks must be left to the decision of the particular port authorities and particular conditions prevailing in each port. Floating docks, however, have been very much favoured during the last few years.

Hamburg is the most complete modern Continental port, and she now has eleven floating docks within the harbour and only one dry dock.

Antwerp, on the other hand, has many dry docks and no floating docks.

The new extension of Plymouth or Devonport Naval Harbour has examples of several magnificent dry docks of all sizes, capable of taking in, with room to spare, the largest vessel afloat.

Floating docks are cheaper and can be constructed in a shorter time, but are not always adaptable to local conditions.

VII.—Approach Channels.

Every port visited has its entrance or approach channel leading up to it from the sea. Great effort is made to develop sufficient depth in these channels for the new ships, and in most cases as much effort is required to maintain the depth afterwards.

The sketches on page 162 of the cross-sections of the various channels to the same scale, will illustrate the comparative width and advantages of the St. Lawrence route.

In many instances the future of a port depends on the possibility of obtaining the necessary depth and of economically maintaining it. Montreal has the magnificent St. Lawrence with its water free from sediment, where the existing channel is 30 feet, and can be made any required depth at a very reasonable expenditure, and when so made does not require maintenance.

In most cases the construction and maintenance of river channels are carried on by the state. To Antwerp it is done by the Governments of Belgium and Holland. To Hamburg by the state, under the same general management as the port. At London by the Thames Conservancy, and is a charge on the shipping.

VIII.—Port Equipment.

Sheds and Storehouses.—For the receipt of freight and baggage and the convenience of passengers, wharf sheds have been developed to a high degree of excellence. They are no longer on trial, and modern sheds are built on permanent foundations and of lasting construction.

In these sheds, besides sheltering goods in storage, the various processes of sorting, passing customs, and examination can conveniently be carried out.

The use of these sheds is limited to the actual time required, and the goods should not remain longer than a few days.

Shed space next the ship should afford ample accommodation or the economic and rapid manipulation of cargo, and usually when ships load and unload at the same berth, where this cannot be had on one level sheds of two or more storeys are provided.

Storage for longer periods cannot take place where shipping will be inconvenienced, and warehouses are then resorted to.

Freight-handling Devices.—One of the greatest lessons to be learned in European ports is the tremendous use made of labour-saving, time-saving, freight-handling devices. Cranes in vast numbers are everywhere. Transporters for carrying packages long distances, carriages for shifting cars from one set of tracks to another. Lifts, chutes and jiggers of all kinds are in evidence.

Equipment must of necessity be planned to meet the special requirements and conditions of the port for which it is intended. It by no means follows that because a given port equipment answers its purpose in its own port that its counterpart will be efficient if placed elsewhere. The chief consideration in deciding upon the nature of a port's equipment would seem to be the special nature of the port's business. The port of Liverpool, for instance, has very little direct railway communication. The bulk of its business is transacted from ship to ship and from ship to vehicle, by means of transit sheds and *vice versa*. Antwerp's business is done from ship to railway, from ship to barge direct, or from ship to vehicle, by means of transit sheds, and *vice versa*.

Hamburg employs four methods, ocean ship to coasting ship, ship to railway, ship to lighter and ship to canal barges.

Manchester, from ship to storage, to railway, and to vehicle.

Here, therefore, are four of the large European ports, each with an enormous tonnage and each handling this tonnage in a different way. It is quite manifest, therefore, that equipment both for handling devices, warehouses and transit shed accommodation must be specially adapted to the special needs of each port.

In Antwerp, where a large portion of the business is done by team traffic, and the area in the port permits sufficient storage space, the transit sheds are one storey and the teams circulate all through them.

In Liverpool, where a large part of the business is carried on by team traffic, but where land area available for storage is limited, the transit shed development is single and double and three storey. Where the sheds are single storey the teams circulate throughout, and both in Antwerp and Liverpool the paving of the sheds to which teams are admitted is stone blocks.

In Hamburg, invariably the transit sheds are set back from the water far enough to admit of between one to four lines of railway and a landing platform for the reception of goods.

In Liverpool this practice is not always adhered to, many of the sheds being close to the water side.

All this goes to show how important it is to fully realize the conditions prevailing in a given port in order to supply the proper development facilities for it.

Fire and Police Protection.—Fire protection is usually taken care of by the city and by the port authorities. Fire engines on land and fire tugs within the harbour, many harbour tugs being equipped with fire-pumps.

Police protection is provided in most cases by the city, though instances are not infrequent where the port authorities undertake this duty.

IX.—Port Administration.

Under this head are to be found great varieties of administrative methods, among which the following are most frequent:—

1. Where the chief authority is vested in the State, as at Hamburg and Devonport.
2. In the municipality, subject to State control, as at Antwerp and Bristol.
3. In private or public companies, as at London and Manchester.
4. In a railway company, as at Southampton and Cardiff.
5. In a public trust, as at Liverpool and Glasgow.

State control in Germany has been unquestionably a marked success, where the railways and waterways also come under the same authority. Mixed control by the State, private corporation and the railways has been a failure, as demonstrated by the loss of business and prestige in Marseille, whereas dual management by municipality and State has produced in Antwerp a great port. London is an

example of private individual effort and a multiplicity of port authority, the river being under one authority, the pilotage arrangements under another, and the docks and quays under the control of the different individuals directly interested in them. This type does not recommend itself to the investigator.

Liverpool, where the organization is in the hands of men who though directly interested in some particular business connected with the port, make their share in its management the pride of a life career, where the expenditure of large sums of money has been carried out with a view to harmonious development as a whole, is another type of successful enterprise.

X.—Port Charges.

Under this head three sources of revenue are being availed of in European ports:—

1. Charges against the ship.
2. Charges against the goods.
3. Charges for rental of berth and shed space.

In London the channel of the river is being deepened by doubling the tonnage dues on the ship for three years.

In Antwerp there is no charge against the goods.

In Hamburg the Hamburg-American Steamship Co. leases seven piers fully equipped by the port authorities with transit sheds, cranes, &c.

The company pays for these privileges:—

1. An annual rental of $325,000 for the space rented.
2. The regular tonnage dues imposed by the port.
3. Maintains the leased property in good condition.

It is, however, universally recognized that the maintenance of a port and the interest on the cost of its development cannot in its early stages be wholly paid out of the charges imposed. It is also recognized as a matter of policy that modern harbour development is essential, notwithstanding the above fact and that the State or the controlling power of the harbour must make up the difference in the cost of maintenance and interest from other sources in the interest of the whole country at large.

XI.—The Financial Situation.

The amount of money represented by modern port development, as near as can possibly be ascertained, is as follows:—

London	$186,700,000
Liverpool	125,000,000
Manchester	90,000,000
Glasgow	40,000,000
Newcastle	80,000,000
Bristol	30,000,000
Cardiff	30,000,000
Antwerp	45,000,000
Hamburg	100,000,000
Rotterdam	33,000,000
Marseille	29,500,000
Havre	24,000,000
Montreal	10,000,000

The rate of interest paid by the port authorities on the money borrowed, sanctioned by corporation or State, varies from $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent.

XII.—Port Design and Construction.

Striking Features of Design and Construction.—The striking features of British and Continental construction are permanence and continuity of purpose. Though the work may be carried on over a large time area, the whole is the result of a complete original plan or leading idea carried out by sections as the demands of the business warrant. Time is taken to carefully consider and prepare complete plans.

In the later development of modern ports no small attention has been given to the artistic effect of the completed scheme. In many cases it has been possible to provide recreation areas, in the shape of broad and spacious promenades for the people, without in any way interfering with efficiency.

Provision for the Future.—Designs are made with a view to future extensions. The more successful ports—as Liverpool, Hamburg and Antwerp—with courage and confidence in the future, provide for anticipated trade. As a result they are the leaders in progress.

Designs are made with a view to future extension.

The more successful ports keep their development ahead of the demand and so capture the trade when it comes.

Antwerp has embarked at this moment on a further port extension scheme, definitely laid down and sanctioned by Parliament, into which is to go $60,000,000.

Engineers.—The engineering profession, through the importance placed upon its integrity and high standing, the remuneration it commands, has attracted to it men of commanding ability and executive skill. They study not only the technical features, but they qualify themselves for expert executive advice and take prominent part in the councils of commercial and corporation boards.

Manner of Construction.—The improvement of rivers, in all its branches, and as a rule the maintenance of docks, is done departmentally—that is, by the officers and men of the port authorities. In Liverpool and Glasgow, where continuous development has evolved an experienced staff and efficient plant, most of the dock construction is also carried out departmentally.

As a rule sheds, equipment and works of a special nature are done by contract.

As a general rule, large works are constructed more rapidly by high grade contractors, but it does not lend itself to modifications due to experience gained as the work progresses, and most engineers claim that when they put in the work themselves they know what they are getting.

Contract Work.—Tenders are invited from firms of known integrity only. The lowest tender is not by any means always taken, and great consideration is given to the contractor's record, to the work he has in hand, to the programme he can put forward, to his organization and plant for the work.

Contractors.—The standing of contractors is very high. Owing to the fact that the lowest tender is not considered of more advantage than the one best equipped for the work, sound firms remain in the business and continue for generations. They ask for prices to make a profit and thoroughly modify without difficulty. Their prices being so much per unit there is very little question of extras. If the work is enlarged they usually continue it without question, asking and obtaining such increase as is fair under the circumstances. They have on their staffs high-class engineers, and the relation between the engineers and the contractors is more easily maintained from the fact that the class of their work is high and there is little cause for friction with regard to extras or overtime. The

contractors' organization is complete, but for economy and labour-saving appliances in construction Canadian contractors have nothing to be reproached with.

The latest method of putting in permanent submarine foundations, as developed by British engineers and contractors, is of the greatest possible moment to Canadians in view of the high cost of timber, its non-permanence and the great height of modern dock walls.

XIII.—General Impressions.

1. The ports that are doing the biggest business and doing it most efficiently, are the ports that have kept their facilities ahead of actual requirements.

2. The ports that have remained stationary or lost in prestige have been those who neglected to provide facilities before business was forced to seek elsewhere the same facilities provided by rival terminals. Business follows the facilities.

3. Unity of authority, concentration of business, depth of water areas, and facilities for despatch of business are the prominent characteristics of successful port administration.

4. The necessity of providing large and convenient storage areas where cargo may be collected and cared for.

5. The lowest cost of handling cargo from the hold of the ship to consignee and *vice versa*, was found to be in a port where one authority controlled the entire operation, and where the transit sheds were three to five storeys high.

6. That special facilities for the care of Canadian perishable products have been provided in British ports on a large and complete scale.

7. That equal facilities should be provided at Canadian terminals.

8. That the legitimate expansion of Canadian trade demands the immediate development of Canadian sea terminals if Canadian business is to be handled by Canadians.

9. That neglect to provide immediately these necessary facilities in Canada will have for effect the establishment of trade routes over which no control can be exerted by Canadians.

10. Great port development has invariably been followed by increase of trade and population.

11. Montreal has the power, through her commanding position and great natural advantages, of affording the best terminal facilities at a less cost than any European port of importance, and this advantage can hardly be equalled by any port on the North American Continent.

Conclusions.

In view of the actual situation at Montreal:—

1. Where the present port development only partly takes care of the existing trade;

2. Where the tonnage has doubled in five years and a vast increase in trade is in sight;

3. Where marine insurance rates have been cut in two in the same time;

4. Where new business can easily be developed with increased accommodation and facilities;

5. Where Nature has provided a thousand miles of magnificent navigation into the heart of a continent;

6. Where interior navigation through Canadian canals provides means of traffic distribution on a scale not equalled by any port in the world;

7. Where direct railway access is provided to every railway in the country on equal terms;

8. Where a 30-foot ship channel now exists from Montreal to the sea with possibilities of enlarging and maintaining it at a lower comparative cost than any European approach channel;

9. Where the aids to navigation throughout a thousand miles of water channel are also of a type not excelled in any other port visited or its approaches;

10. Where comparative port expenditures to date are entirely in favour of Montreal.

In view of these facts, it would seem to be most urgent to supplement without loss of time these great advantages:—

1. By making the most of our present accommodation through its proper equipment;

2. By doing everything in our power to attract shipping by securing absolute safety of approach;

3. By laying down a general plan of future development with a view of providing at Montreal a port equipment equal to that of Hamburg or Liverpool;

4. By encouraging the railways serving the port of Montreal to develop more intimate traffic relations with the railways serving the British and Continental ports;

5. By developing and equipping a modern winter port providing ample accommodation to take care of the trade developed through Montreal during the season of navigation;

6. By incorporating in the future general plan of expansion a free port district after the model of Hamburg: and so inaugurate a port development on Canadian soil which, by its prestige of position and strategical trade value, will command not only Canadian business, but a large part of the Western export and import business of the North American Continent.

PORT OF LIVERPOOL.

I.—Introduction.

Within the massive walls of a newly-constructed administration building, looking out over the entire harbour, throbs the heart of the greatest port in the world.

Although Great Britain's sea power during Elizabethan times achieved a position that has since preserved her commercial integrity, Liverpool's maritime commerce was then being carried by fifteen ships, with an aggregate burthen of 268 tons. The sand dunes sloping to the river were undisturbed by artificial construction, and no shelter for ships existed.

Nature has, however, been overcome by the courage, persistence and skill of determined men, who, in the words of a former dock chairman, have made of Liverpool "a purse out of a sow's ear."

Municipal control retarded for years the port's development, as did also a compromise arrangement whereby a division of authority existed, part elected by shipowners and part municipal. The destinies of the port by Act of Parliament came under the jurisdiction of the Mersey Docks and Harbour Board, in whose hands the port has had continued harmonious development for over half a century.

Trustees of an inheritance the magnitude of whose responsibilities remain unmatched, the Board's present organization numbers among its members some of the most eminent men in Liverpool, who deem it of the highest honour to take part in the deliberations of the board, without any remuneration whatever.

II.—Ocean Business.

Liverpool handles about ninety per cent of the entire cotton trade of Great Britain, in addition to which she handles grain, wool, timber, sugar, tobacco, provisions, cattle, and fruit in large quantities.

By making use of every inch of possible space at the dock side it has been possible to increase in one hundred years the number of vessels from 4,000 to 25,000 entering the port, and the tonnage from 500,000 to 12,000,000. The dues have increased in the same time from $225,000 a year to $6,500,000.

III.—Features of Success.

Up to the year 1857 the controlling authority of the port on the Liverpool side of the River Mersey was vested in a dock committee, whose action was subject to the control of the Liverpool town council, who were the then trustees of the Liverpool docks. The docks on the opposite side of the river at Birkenhead were owned by a company styling itself "The Birkenhead Dock Company," up to about the same time, when they were purchased outright by the Corporation of Liverpool. Unity of purpose, concentration of authority and the gateway to a densely peopled manufacturing area, are the three chief factors in making and preserving her prestige as a port.

IV.—Types of Port Business.

(*a*) *Ocean Ship to Coasting Ship.*

Liverpool has always been a large port of transfer where her ocean imports might be redistributed to foreign and home ports not trading directly with the large trade centres, situated in far-off parts of the world.

(*b*) *Ocean Ship to Railway direct.*

The necessity for direct railway communication between the different docks is only just making itself felt. The reason of this seems to be that whereas in former times Liverpool was almost exclusively a warehousing port, goods in transit being conveyed between the ships and warehouses by vehicle, competition is bringing about a demand for the saving in handling made possible by direct shipment from ship to rail, and *vice versa*, and the proportion of Liverpool's general cargo business directly shipped is increasing year by year.

(*c*) *Ocean Ship to Warehouse by Vehicle.*

This has always been the favourite handling method in the port, and facility is afforded for the despatch of merchandise by this system. The huge dray loads drawn by heavy-class horses admirably suited to the work form a marked characteristic of the port.

V.—Port Types.

The port of Liverpool explains the power and possibilities of artificial development, as the whole of it consists in a series of docks constructed in most cases on the foreshore and entered by means of gates from the river proper. Thus the entire shipping of the port, when once docked, is entirely free from the annoyance of tide variation.

VI.—Dry Docks.

The Harbour Board own seventeen dry docks, of which the Canada Graving Dock enjoys the distinction of being the largest graving dock in the world.

The description of this dock is as follows:—

Length from point of sill to dock head	925½ feet.
Length occupied by keel blocks	925½ "
Width of entrance	94 "
Width of dock at floor level	94 "
Width of dock at cope level	124⅙ "
Depth of dock from cope to floor	40⅓ "
*Depth of water over sill at H.W.O.S.T.	31⅚ "
*Depth of water over sill at H.W.N.T.	24 7/12 "
Depth of water over keel blocks	Same as on sill.
Capital cost of Canada Graving Dock (including 40 ton crane, but excluding land)	$1,193,660

In addition to the graving docks owned by the Dock Board there are several privately owned dry docks in the port.

VII.—Approach Channels.

The approach to Liverpool is by way of the Irish Channel, Liverpool Bay, and the River Mersey, at whose mouth the port itself is situated.

VIII.—Accommodation for Vessels.

——	Water Area.	Lineal Quayage.
	Acres.	Miles.
Total water area and lineal quayage of Liverpool Docks acd Basins	418	27
Total water area and lineal quayage of Birkenhead Docks and Basins	166	9
Total	584	36

Total area of Dock Estate.

Liverpool	1,171 acres.
Birkenhead	506 "
	1,677 "

* The depth of water can be increased as desired by pumping.

The 27 miles of Liverpool's lineal quay length is concentrated within about 8 miles of water front.

This wonderful development, representing such vast expenditure, made almost entirely since 1857, when the port was rescued from the administration of the Liverpool Town Council, is hardly paralleled by any other port in the world.

IX.—Port Equipment.

In addition to possessing the largest graving dock in the world, which has been appropriately named after the largest colony within the Empire, and called the "Canada Graving Dock," Liverpool enjoys the distinction of possessing also the largest single warehouse in the world, which is one of a system of 27 blocks of warehouses under the control of the Dock Board. The total area of its 14

floors is 36 acres; it is constructed of brick and steel, and fitted with hydraulic lifts for goods and passengers. It has a capacity for 66,000 hogsheads of tobacco, the approximate weight of which is 77,000,000, pounds. The value of its contents is $12,000,000, and the amount of duty payable on the 66,000 hogsheads would be, at 72 cents a pound, the prevailing rate, about $55,000,000.

Special facilities for handling cattle have been provided and centralized at Birkenhead, and these are among the most extensive and complete in Great Britain.

Railways have direct access to these slaughter-houses, and rapid and efficient distribution of their contents is made throughout the Kingdom.

On the Liverpool side it was a pleasure to note that the Canadian Pacific Railway have secured permanent allotment at the Sandon Dock with its fine double-storey sheds, and have at their own expense equipped these sheds with extensive cold-storage arrangements to meet the requirements of Canadian shippers and importers of perishable products. By these means the butter, cheese, fruit, and meat from Canadian farms are carried direct from the cold-storage chambers in the ship into the refrigerated chambers on the quay.

Liverpool having also a large passenger trade, special passenger facilities have been provided. The well known landing stage, with its fine deep water approaches, its proximity to the main lines of railway, make it possible for passengers and baggage to be transferred within the least possible time. This method of accommodating passenger traffic has taken the place of the old system under which the ships anchored out in the river and discharged their passengers and baggage into tenders. This landing stage, so well known to ocean travellers, is a huge structure floating upon pontoons, and is about 2,500 feet long, and rises and falls with the tide. From it to the railway station alongside lead numerous automatically adjusted bridges for passengers and platforms for baggage, altogether the best passenger facilities in the world, affording comfort and despatch.

The different docks and quays are supplied with hydraulic, steam and electric cranes of varying capacity, one of the most recently erected being a coal crane with a capacity of 30 tons, lifting a car wagon at a time. The number of hydraulic, steam and electric cranes at the cargo quays exceeds 230 of a capacity of from one to 100 tons, and the height of lifts vary from the ground floor to 106 feet. There are also floating cranes varying in capacity from 25 to 100 tons, capable of lifting 95 feet above the water level.

At Liverpool two main lines of railway run in close proximity to the docks throughout their entire length, and many of the berths appropriated to the largest class of steamers are connected with the main lines to enable direct shipment from ship to railway wagons to take place, and the connecting up of other berths with the main lines is progressing rapidly. Birkenhead is practically a railway port, lines of railway being laid in every possible direction, and the main bulk of the traffic is carried in railway wagons. Within the dock estate there are over 75 miles of railway.

Above the two main lines of railway on the street level an overhead passenger railway, worked by electricity, has been constructed. This railway was primarily made for the convenience of passengers having business at the docks, but steps are now being taken to connect the railway with some of the main systems running into the city, with a view of its being more extensively used by passengers and also for goods traffic.

Almost opposite the landing stage can be seen the new and modern shipbuilding yards of Messrs. Cammell, Laird & Co. The site, owned by the Mersey Dock and Harbour Board, is leased to this company for 50 years, and the company has constructed a large dock with a water area of 15 acres, the entrance thereto being 90 feet and the depth over the sill 37 feet. A large graving dock 860 feet long, and numerous high-power cranes, fitting and repairing shops, are easily and rapidly accessible to the shipping of the port.

Two-storey sheds have been in use in the port of Liverpool for 25 years, and the latest shed development is now three-storey. The adoption of three-storey sheds in a port like Liverpool, where the land area available immediately alongside the dock is limited, has the effect of trebling the port's storage capacity, and is the only available method in ports so constituted to provide adequate and efficient transit facilities for the rapid handling of cargoes. The lower floors of these sheds are almost invariably square setts. The upper floors are of concrete. The latest three-storey shed is built entirely of concrete (reinforced) from top to bottom. The means of communication between the different floors within the shed itself consist of openings in the floors, at convenient intervals, down which small jigger cranes do their work. When working the first floor from the ship the cargo leaves the hold of the ship by means of the ship's winches and tackle, the land cranes taking the cargo from the ship's deck and depositing it on the ground or first floor of the shed. The land cranes can take the cargo direct from the ship's hold, if required. The cargo is then distributed at will on any of the shed floors by means of chutes and the jigger cranes referred to. On the land sides of the sheds are fixed to the outer wall a second series of small jigger cranes, and the goods are lowered from floor to floor or floor to ground in this way.

X.—Port Administration.

In 1857, by virtue of the Mersey Docks and Harbour Act, the control and management of the docks on both sides of the river at Liverpool and Birkenhead passed into the hands of the present Board, which consists of 28 members, of whom 24 are elected by the dock ratepayers. To qualify for election to the Board a ratepayer must reside within the borough of Liverpool or within 10 miles of the outward boundary of the port, and must pay within the year immediately preceding the election not less than $125 in dues, either on ships or goods coming to the port. The remaining four members are appointed by the River Mersey Conservancy Commissioners, consisting of the First Lord of the Admiralty, President of the Board of Trade, and Chancellor of the Duchy of Lancaster. Each member is elected for a term of four years, and is eligible for re-election, receiving, as stated before, no remuneration whatever, the position being regarded as one of the highest honours within the gift of the people, and this honour is loyally observed.

To qualify as an elector a ratepayer must pay to the Board a minimum yearly amount in dues of $50, must be a British subject, or resident within the United Kingdom, and his name must be on the list of dock electors.

Six elective members and one appointed member retire each year, and are replaced by newly nominated men.

The Board itself replaces vacancies occurring from time to time.

The work of the Board is carried on by committees, of which there are 10. The committees themselves meet once a week, as does also the whole board. The reports of the different committees are submitted to the weekly meeting of the Board for official approval. The meetings of the different committees are private, whereas the weekly meeting of the entire Board is held in the Board room and is a public meeting. The Board is presided over by a chairman elected annually from among the members.

The Mersey Docks and Harbour Board licenses pilots, regulates charges, and looks after the lighting and buoying of the river.

The jurisdiction of the Board already extends over an area of 1,677 acres, but in addition to this the Board has foreseen the necessity of future expansion, and has acquired large tracts of land admirably situated for further port extension.

As a harbour policy the Board has not hesitated to wipe out of existence any formerly constructed dock development that interfered with the demands of

expansion, and many instances were noticed of permanent works disappearing where necessity demanded, to make way for new conditions.

The ship's responsibility in the handling of goods ceases at the ship's sling, and the cargoes are delivered into the hands of master porters, licensed by the Board, who sort the cargoes in the sheds to bill of lading marks and deliver them to the consignees.

The charge made for this service is regulated by the Dock Board. Loading is done by master stevedores and the unloading by master lumpers, also licensed by the Board. Where, however, the Dock Board works its own warehouses, goods on the quays are usually handled by their own employees.

Through the perfected master-porterage system consignees get their goods delivered in the shortest possible time with little confusion and at a very small cost.

A limit is fixed of 72 hours during which time the goods may remain on the quays after the docking of the ship. A charge of one cent per yard per day is made for space occupied after this time.

XI.—Port Charges.

Charges against the ship are divided into two categories; those levied on the nett tonnage of ships entering the port of Liverpool, and known as harbour dues, varying from $\frac{3}{4}$ cent to $1\frac{1}{2}$ cents per ton on coastwise business, 3 cents per ton on vessels to and from Europe, Newfoundland—the Mediterranean excepted—and 3 to 4 cents per ton on vessels to or from Mediterranean and all foreign ports outside of Europe. A deduction of 25 per cent is at present allowed from these harbour dues. The above rates constitute the tonnage dues paid by shipping entering the port of Liverpool. In addition, however, the ship pays tonnage dues for the use of dock accommodation as follows:—

	Cts. per ton.
On vessels to or from Mediterranean and all foreign ports outside of Europe.....	32
To and from Europe, Newfoundland, the Mediterranean excepted.....	20 to 26
Coastwise.....	$5\frac{1}{2}$ to 12

Ships remaining in dock more than two months pay a rental of 2 cents per ton per week, which is increased to 4 cents per ton per week after 6 months.

Ships using dock accommodation are not charged harbour dues, and against these only the dock tonnage dues apply.

In the Dock Board method of accounting, however, the harbour rates are taken out of the dock tonnage rates and placed to the credit of the account, to which are applied the cost of lighting, buoying, and generally for improvement to port and harbour as distinct from the docks themselves.

Ships having permanent annual berths pay a shed rental equal to 62 cents per square yard per annum. The same price is paid for space on the second and third storeys of the sheds as for the ground floor.

Charges against the goods are levied according to specified tariffs issued from time to time.

XII.—Financial Situation.

The amount of capital invested in this dock development, for which money has been borrowed by the Mersey Docks and Harbour Board, amounts to nearly $125,000,000. The rate of interest varies from $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent.

The accounts of the Board are regularly audited by independent auditors.

Revenue and expenditure figures for year ending July 1, 1906, are as follows:—

	$ cts.
Dock tonnage rates on vessels	3,203,033 09
Dry dock rates "	190,490 05
Dock rent "	56,857 25
Dues on goods	3,241,199 28
Slaughter-houses	336,302 72
Warehouses (receipts)	1,090,962 79
Interest paid by Board	4,327,667 06
Dredging	179,566 64
Lighthouses, lightships, buoys and insurance	188,483 61

PORT OF LONDON.

I.—Introduction.

London being the financial, commercial, and maritime centre of the world, has held this commanding position in spite of huge port developments that have taken place elsewhere in the last half century, in spite of natural difficulties and those artificially raised by local conditions within her own limits. This has been possible mainly because of the sagacity of her traders, her advantageous position as a distributing centre, and the huge consuming power of her densely-peopled surroundings.

For many years attempts have been made to improve conditions within the port. Diversity of interest, multiplicity of authority, and the power of long-established customs have stood in the way.

London has not yet lost her pioneer position. Signs point to the necessity of reorganization on a big scale to take care of the future.

The ownership, hitherto individual or corporate, is by virtue of several years' work about to culminate in the foundation of a new Port Authority, by Act of Parliament, which will consolidate the different interests under single control and permit harmonious expansion.

II.—Ocean Business.

The river life of the Thames is like that of a crowded thoroughfare, the huge overtowering ocean liners, the coastwise ships, the fishing craft, the coalers, the barges and lighters all jostling each other in the tideway like throngs in a busy street. Here it is that all the world meets—India, Ceylon, China, Japan, South America, Africa, Australia, Canada, United States, Mexico, and Europe in one huge interchange of trade. It takes nearly 20 million tons of inward shipping and a similar tonnage of outward shipping to transact the enormous business of the port of London. The annual volume of the imports and exports is $1,570,000,000, including exports of foreign and colonial merchandise.

III.—Features of Success.

History fails to reveal accurate details concerning the earliest development of the port. With the growth of London's commercial prestige, far-sighted merchants saw the benefits to be derived from dock development. The more sagacious purchased the land areas in the neighbourhood of the port expansion, and so it is that London has been supplied with dock facilities by the investment of private and corporate capital at different times, thus introducing several independent owners on a competitive basis within the limits of the port.

As long as London controlled the monopoly of trade distribution this method was found to answer the needs of the situation, but other British and continental ports became alive to the transformation that was on, in the size of ships the world over. Hamburg, Rotterdam, and Antwerp on the continent; Liverpool, Bristol and Southampton all became better equipped to handle the big ships. As a consequence London now finds herself compelled to do likewise.

IV.—Types of Port Business.

(a) *Ocean Ship to Coasting Ship.*

This has always formed a very considerable portion of London's business, redistribution taking place through a well organized coasting service.

(b) *Ocean Ship to Warehouse by Lighter.*

The lighterage trade on the Thames is perhaps the most characteristic as well as the most picturesque feature of river life. The proximity of warehouses to the riverside, the free access of the lighters to all the docks, and the tidal nature of the river make this a popular and economic method of transfer.

Both sides of the River Thames from London Bridge down are for miles lined with warehouses which take in cargo direct from the river, either from lighters or from the smaller ships that moor alongside.

These barges are owned by private companies or individuals, and are licensed by the Watermen's Company at $125 per barge with renewal fees of $1.25 per annum for any number not exceeding five, and $2.50 for any number over five.

No revenue to the port of any kind comes from these barges, except on sailing barges over 45 tons register, trading between London and other ports, which, of course, pay the coastwise tonnage dues.

As no sea-going ships, except a few specially built colliers, pass above London Bridge, there is an immense lighterage trade done from the ship's side to warehouse or jetty, the volume of which can be imagined when in round figures there are engaged in this trade nearly 10,000 barges, varying in tonnage from 70 to 200 tons.

V.—Port Types.

The port of London, like most of the European ports, is tidal, and its development has consisted of three phases:—

Riverside quays.
Interior docks.
Water berths.

The riverside quays are those on the banks of the river where vessels may come straight up from the sea alongside their berth and remain afloat.

Water berths are simply moorings or anchorage places in the river, marked by permanent buoys of sufficient strength to permit ocean craft to tie up to them. Of these water moorings there are 62 tiers, accommodating 121 ships. These are generally used by small vessels, but occasionally by ships up to 5,500 tons net register, which unload general cargo overside into barges by means of the ship's crane and tackle. They are also specially used by tank steamers with high-test lubricating oils.

In addition to these, there are 16 swinging moorings, each of which holds one vessel. The number of vessels using this class of berth that do not touch the riverside wharves or enter the docks, but take up their moorings in the river at these buoys, is annually 3,000, with a net register tonnage of 1,600,000 tons. Vessels availing themselves of this accommodation pay no charge other than the usual Conservancy tonnage dues when entering and leaving with cargo.

Almost one half of the shipping coming up the Thames discharges in the river itself, either at moorings in the stream or at one of the 320 wharves which line the river. The other half discharges in the docks.

The wharves and jetties in the river are estimated to contain 80,000 linear feet of quay, and are estimated to have cost $65,000,000.

All the principal docks in the port of London are owned by dock companies, and have been built by private or corporate capital as an investment.

Of these the most important and extensive is the London and India Dock Company, within whose jurisdiction come all the dock systems on the north side of the river, with the exception of those of the Millwall Dock Company, the latter company being practically the only competitor of the London and India Docks Company on that side of the river.

On the south side of the river the Surrey Commercial Dock Company, in like manner, own all the docks.

The distance of the various dock entrances from London Bridge, in nautical miles, is as follows :—

St. Katharine Docks	½
London Docks—	
Hermitage entrance	¾
Shadwell entrance	1½
Surrey Commercial Docks—	
Surrey lock entrance	1½
New entrance	3
West India Docks—	
Limehouse entrance	2½
Blackwall entrance	5½
Millwall Dock	3¼
East India Docks	5¾
Royal Victoria Dock	6¼
Royal Albert Dock	9¼
Tilbury Docks	22¾

The dock premises consist of various systems of wet docks, dry docks, warehouses, machinery and plant.

A wet dock is an artificial basin of water furnished with gates which are kept closed, except at high water, so that vessels in the docks float at a constant level, notwithstanding the variation in the depth of water in the river or sea outside. It is this feature that distinguishes docks from harbours.

Vessels generally enter or leave these docks a short time previous to or after high water.

The advantages of docks, as compared with harbours or open rivers, are stated to be:—

1. Constant flotation of the vessel.
2. Concentration of business.
3. Maintenance of a fixed water level, which facilitates the rapid discharge or loading of vessels.
4. Immunity from collision.
5. Greater safety at all times.
6. Security against robbery of the cargo.

VI.—Dry Docks.

The port of Landon possesses twenty-eight dry docks varying from 161 to 846 feet long with entrances 40 to 70 feet wide and depths on sills from 14 to 35 feet at Trinity High Water.

VII.—Approach Channel.

Between Margate and The Naze, where the estuary of the Thames may be said to begin, there are 28 miles of water, which narrows down to 6½ at the Nore Light. The length of the channel from the Nore Light to London Bridge is 47½ miles, the depth and widths of which are as follows:—

	Width.	Depth.
	Feet.	Feet.
Nore Light to Mucking, a distance of 13½ miles.....	1,000	26
800 feet of this, however, near No. 4 Sea Reach Buoy, narrows to.....	800	25
Mucking to Cliffe Creek, a distance of 2½ miles.....	1,000	25
Cliffe Creek to Gravesend, a distance of 4 miles.....	1,000	26
Gravesend to Crayfordness, 8¼ miles..... (Narrowing down to 750 feet and 17 feet depth.)	1,000	24
Crayfordness to Royal Albert Dock, 5 miles.....	500	22
Royal Albert Dock to Millwall Dock, 7 miles.....	300	14
Millwall Dock to Thames Tunnel, 2 miles..... (The depth, however, over the Tunnel remains at 13 feet for a width of 120 feet.)	300	16
Thames Tunnel to London Bridge, 1½ miles.....	200	14

These depths are from soundings taken at low water of ordinary spring tides.

At London Bridge the variation in tide is about 21 feet, at the Nore Light 15 feet, and has a velocity varying from 2½ to 4 knots.

The bed of the river is mostly mud and fine sand.

Continuous dredging takes place, but the ebb and flow of the tide seems to fill up in certain places as fast as the dredges can take it away.

VIII. and IX.—Accommodation for Ships and Port Equipment.

London and India Docks Company.

Out of the total of 640 acres of water and 143,000 linear feet of quay length, this company owns and controls 430 acres of water and 106,000 feet of quay.

Its jurisdiction extends over—

(1) The St. Katharine Docks.
(2) The London Docks.
(3) The West India Docks.
(4) The East India Docks.
(5) The Royal Albert and Victoria Docks.
(6) The Tilbury Docks.

The number of vessels entering in 1904 to discharge was 4,665 with a net tonnage of 5,959,000 tons.

The permanent staff of this company numbers 4,600, including 340 in the Engineer's Department alone, which carries out the work of maintaining the docks; and 324 in the Police Department, which is responsible for the protection of the valuable produce stored in the warehouses.

The Dock estates cover 1,800 acres, and they possess a floor area of 15,500,000 square feet available for the handling or storage of over 900,000 tons of goods.

The company owns and operates warehouses in the city, and does a general warehousing business.

The St. Katharine Docks are only accessible to steamers of moderate size, mostly used in the coasting and continental trades. The warehouses are used principally for the storage of tea, 32,000 tons of which are housed and delivered annually.

London imports 169,000 tons of tea annually, mostly from India and Ceylon.

Other goods handled at these warehouses are indigo, wool, bark, gutta-percha, and india-rubber.

There are three hydraulic engines at this dock, of 630 horse-power, to supply them with power.

The London Docks adjoin the St. Katharine Docks, and occupy 100 acres, 40 of which are water. The storage capacity of the warehouses and vaults is vast. The floor area consists of 3,000,000 square feet, with a capacity of 170,000 tons. Special premises are set apart in these warehouses for the working and showing of wool, wine, brandy, sugar, dried and green fruits, ivory, spices, bark, gums, metals, drugs, dates, pepper, rice, coffee, cocoa, isinglass, &c.

One of the special features of this dock is its wine vaults, down below the river level. The length of the passage ways in these vaults is $28\frac{1}{4}$ miles.

West India Docks.—The entrance to this dock from the River Thames is 480 feet long and 60 feet wide and 30 feet deep. In order to make up for the losses of water caused during the ingress and egress of ships through these locks into the dock, four centrifugal pumps of 760 indicated horse-power are provided, with a capacity of 7,500,000 gallons an hour, sufficient to raise the water over the entire area of 105 acres $3\frac{1}{8}$ inches an hour.

These docks consist of 244 acres, 105 of which are water. There are three parallel sets of docks, each about half a mile long, with warehousing accommodation close to the water. The principal business consists of rum, meat, sugar, butter, hops, and all kinds of wood.

The large frozen meat trade, mostly from New Zealand and the Argentine, is accommodated at No. 5 Warehouse, where there is room for 100,000 carcasses of sheep. The meat received is discharged either direct from the vessels or from insulated barges conveying it from vessels discharging at other docks. The temperature is kept at an average of 19° Fahr., or 13° below freezing point. The process used is that of De La Vergne compressors, constructed by Haslam and Company, of Derby.

There are seven hydraulic engines, of 700 indicated horse-power, pumping the pressure water to work the 280 hydraulic machines in this system of docks.

East India Docks.—These consist of an import and export dock, and a basin, the entrance to which is by a lock 31 feet deep.

The docks are principally used by sailing vessels and steamers of the Union Castle Line, trading to the Cape. Three hydraulic engines, of 181 indicated horse-power, supply the pressure water for working the 100 hydraulic machines in these docks.

Royal Albert and Victoria Docks.—These are the largest in the control of the company. Water in the docks is maintained at high-water level by four centrifugal pumps with a capacity of 7,500,000 gallons of water an hour.

Water area is 183 acres, providing berths for 60 vessels. The sheds and warehouses of these docks cover an area of 3,100,000 square feet.

The warehousing business here carried out is principally in grain, tobacco, and frozen meat. 20,000 tons of tobacco are in bond at one time, the market price of which would be about $45,000,000. The stores for the frozen meat business are probably the largest in the world, containing 48 chambers of 2,000,000 cubic feet capacity, affording accommodation for 600,000 carcasses of sheep. The freezing plant is on the ammonia compression system of Messrs. Haslam of Derby, whereby air is cooled in passing through brine batteries, and then circulated through the chambers by electrically-driven fans.

There are seven hydraulic pumping engines, with an indicated horse-power of 1,223, supplying power to work the 320 hydraulic machines at these docks.

Tilbury Docks.—These docks are 26 miles from London Bridge, reached by rail in 40 minutes. The system consists of a main dock, with three branch docks, and a tidal basin with a lock 700 feet long and 80 feet wide connecting the basin with the main dock. The main dock is 1,800 feet long and 600 feet wide. The total water area in the main and branch docks is 54 acres, and the depth of the water is 38 feet. In the tidal basin the depth is 45 feet at high water, spring tides, and 26 feet at low water.

Town Warehouses.—In addition to these wet docks and warehouses adjacent to them, the Dock Company operates town warehouses at different parts of London for the storage of goods and for the accommodation of traffic to and from the docks.

The Commercial Road Warehouse, the most modern operated by the company, is built over the goods depôt of the London, Tilbury, and Southend Railway. The depôt is specially designed for the accommodation of traffic to and from the docks. Cars may go alongside the railway platforms, where goods are delivered direct into the railway trucks, or *vice versa*. This warehouse has four floors, with a total area of 358,000 square feet, and is almost entirely used for the storage of cheese and tea.

Equipment.—Within the dock system operated by this company there are 39 swinging or draw bridges, 62 pairs of lock gates, 279 sluices, 1,336 cranes and lifts, 340 capstans, and many other machines; and the movable plant consists of 20 tugs, 5 floating cranes, 30 locomotives running over 80 miles of railway. The machinery used for the working of this immense plant is principally hydraulic.

The handling devices on the quays consist of traveling and fixed cranes, for the discharge and loading of goods, varying from 30 cwt. to 5 tons capacity.

The handling devices within the warehouses for the interchange of cargo from one floor to another consist of elevators ranged in pairs, with a capacity of 10 to 15 cwt.

The handling devices on the water consist of floating cranes for heavy lifts up to fifty tons; steam tugs for the transport of vessels in the docks, which are fitted with steam fire engines for use in case of fire.

There is also an electric lighting plant of sufficient capacity to light the warehouses and docks.

Transit Shed Accommodation.—In addition to warehouses from four to six storeys, there are two types of sheds in use:—

1. A single-storey shed, 350 feet long and 120 feet wide, set back about 40 feet from the water, with rails both in front and rear, so that goods may be conveyed to and from vessels to any railway station in Great Britain.

The sheds are of cheap construction, galvanized iron sides and roof, floors of wood or concrete, no posts in the sheds, and no teams allowed inside. All cargo handled by teams is handled from the side of the shed, where the teams back up and take their load, the floor level of the shed being equal to the height of the teams.

2. The double-deck sheds are of the same cheap construction and comparatively of the same dimensions, set back from the water front sufficiently to allow cranes and railways between them and the edge of the quay wall. The only means of access into the sheds from the ship is by the cranes, and the only means of communication between the upper and lower floors is by means of slides and lifts.

Berths.—Two systems of allotment in connection with berths are in force—one exclusively used for export, where a ship takes on her cargo only, unloading at a different berth; the other where the cargo is loaded and unloaded at the same berth. The berths in the dock are rented by the week at the rate of about $1 per square yard per annum, with the use of the ground floor of the shed only.

Communication.—All docks, with the exception of the St. Katharine, are accessible by rail, water and teams, and are directly connected with all the main railways, whose trucks are brought alongside, the dock company receiving on their tracks the cars from the different railway companies and operating them as a terminal over the eighty miles of trackage within the system.

The Surrey Commercial Dock Company..

The Surrey Commercial Dock Company, however, have made a specialty of accommodation for Canadian produce, and two miles below London Bridge on the south side of the River Thames there was opened in 1904 the Greenland Dock, 2,400 feet long and 450 feet wide, and here has been erected and equipped a series of cold-storage warehouses and grainaries for the specific purpose of properly treating Canadian cargoes of butter, cheese, bacon, and Canadian grain. The warehouses are called 'Canadian Produce Warehouses,' and are known by that name, the combined capacity being about 2,000,000 cubic feet.

The Canadian trade in London is known as North American traffic. These produce warehouses are set about 120 feet from the water side, and between them and the ship is a one-storey transit shed, also set back about twenty feet from the ship's side, in front of which are six movable cranes of the following capacity:—

One	5 tons.
One	2 tons.
Four	3,500 lbs.

The ship is boomed out twenty to thirty feet from the wharf to allow barges between the wharf and the ship. Cranes are here deemed to be indispensable although they do not pay. By their means, however, the ship unloads and loads out in seventy-two hours. The ship sorts to bill of lading, and is required to re-deliver on to teams of consignee or on the ground of the dock company when desired. In sorting to bill of lading the floors are marked with chalk and numbered according to the manifest, goods being sorted in blocks like warehouses. Behind the sheds the warehouses are three storeys high, and the cheese and butter pass through the transit shed into the cooling rooms of the warehouse by means of conveyers temporarily erected for that purpose. There is a continuous and rapid stream of cheese boxes leaving the ship and reaching cold storage without delay.

The method of handling the freight between the different storeys consists of five double groups of lifts or elevators with a capacity each of 1,500 lbs., and six cheese loaders with a capacity of ten to fifteen tons per hour. Through these warehouses 47,000 tons of Canadian cheese passed last year. The perishable freight, therefore, is immediately transhipped from the refrigerating holds of the steamers direct into the cold storage on the quay side. From the warehouse to Tooley street, the great produce market of London, two miles away, this cargo is loaded mechanically under cover into huge vans and carted to the market as the demands of the trade require. When visited, the Thomson liner *Latonia*, and the Allan liners *Parisian* and *Pomeranian* were berthed alongside these transit sheds. Everywhere the most scrupulous care and cleanliness is noticeable, and the quality and condition of produce here housed left nothing to be desired. This dock company also makes a specialty of lumber, and has large areas devoted to lumber ponds and stacking ground.

Millwall Docks.

Millwall Docks, situated on the north side of the river below the India Docks, has an area of 233½ acres, of which thirty-six acres are water. Entrance to these docks is by a lock, 450 feet. Ships of greater length can, however, pass through at high tide when both gates are open. The company accommodates a special trade in grain and timber, for which purpose the docks are specially equipped.

The total water area of the London Docks is 640 acres; the land area, 1,660 acres; shed and warehouse fioor space, 390 acres.

Cold storage at the shipside of 4,500,000 cubic feet.

X.—Port Administration.

Authorities within the Port.

1. The Thames Conservancy.
2. The Trinity House.
3. The Watermen's Company.
4. The Corporation of London.

The authority of the Thames Conservancy begins 161 miles above London Bridge and extends to the sea. The bed and soil of the river below high-water mark of ordinary tides is (with the exception of certain Crown foreshores) vested in them.

Within its jurisdiction fall the following duties:—

River and channel maintenance.

Regulation of navigation.

Supervision of all explosives and petroleum.

The maintenance of all public moorings, the use of which are free to the ships.

The marking, watching and removal of wrecks and all obstructions from the channels (section 77 of the Thames Conservancy Act, 1894).

The dredging of the river for the improvement and maintenance of the navigation.

The prevention of pollution.

No jetty, embankment, pile mooring or any other work is allowed to be placed below high-water mark without the license of the conservators, and the payment of a consideration fixed by the assessor under section 116 of the Thames Conservancy Act, 1894, either by way of a sum in gross or an annual rental.

The Trinity House lights and buoys the river, licenses and regulates pilots, examines all persons who are qualifying to be dock masters in order to certify that they are competent to handle ships, and exacts a contribution of 2½ per cent upon the earnings of all licensed pilots, which goes to a pilot fund. In addition to this, each pilot pays $15 a year upon the renewal of his license.

The Trinity House also examines masters and mates of vessels and grants to them certificates which make the employment of qualified pilots in the district non-compulsory.

Pilotage is compulsory, with certain exceptions.

The Watermen's Company license the lightermen who navigate the river, and originated in the sixteenth century and held for four generations the monopoly of the navigation of the River Thames under various Acts and ordinances of the Crown.

The Corporation of London is at once the sanitary, the police and the fire authority of the port. It safeguards the port from entrance, by way of the river, of infection and disease, brought in either by persons or goods or in the form of unsound food.

Through the Metropolitan Police Force the river is patrolled and crime detected and suppressed, who also enforce the Acts and by-laws of the Conservators.

The City Fire Brigade operates and maintains the necessary fire stations and fire boats on the river, for which purpose the Thames is considered as a London thoroughfare.

XI.—Port Charges.

Charges against the Ship.

1. Tonnage dues levied by and paid to the Thames Conservancy, devoted largely to the maintenance of the channel—

2 cents per net registered ton, coastwise vessels.
3 cents per net registered ton, all other vessels.

These dues are levied on all vessels entering or leaving the port with cargo, so that a vessel going to and from the port with cargo pays twice.

2. Dock dues, levied by the different dock companies on vessels entering the docks with cargo, vary from 6 cents to 36 cents per net registered ton.

3. Light dues, levied by the Trinity House—

On Vessels in Home Trade.

2 cents per net registered ton per voyage, on sailing.
3 cents per net registered ton per voyage, on steam.

Less 20 per cent per voyage for ten voyages if in home trade all the time. Subsequent voyages in same year free.

On Vessels in Foreign Trade.

4½ cents per net registered ton per voyage, on sailing.
5½ cents per net registered ton per voyage, on steam.

Less 20 per cent per voyage for first six voyages within year. Subsequent voyages in same year free.

4. Pilotage rates—

About 6 cents a ton in and out.

5. Rent after expiration of privilege allowed under respective rates of dock dues—

2 cents per ton per week.

Bona fide lighters or craft used in discharging or receiving ballast or goods pay no dock charges.

Charges against the Goods.

Levied by the dock companies, and paid by the merchant:—

'On every article of goods, wares or merchandise brought into and landed or deposited within, delivered to land conveyance from the docks within their jurisdiction, always excepting goods discharged or received overside from vessels to or from barges.'

1. Wharfage rate (includes receiving from ship and delivery to land conveyance)—

60 cents per ton on sand, lead, &c., to
96 per ton on bismuth, ore, &c., and upwards, according to tariff.

2. Landing rate (includes landing or receiving by land, wharfage, weighing, loading from quay to land conveyance)—

60 cents per ton to $1.50 per ton.

Consolidated rate—

From $1.36 per ton (includes landing or receiving by land, wharfage, weighing or gauging, coopering or mending, piling on the quay, six weeks' rent, from date of ship breaking bulk, first landing from craft or first receipt from land carriage, delivery to land or water conveyance). Additional services if required.

Goods or ballast to or from ships entering or leaving the docks in lighter are exempt from dock dues.

Measurement rates are given in a tariff issued from time to time.

The lighterage rates for conveying goods in barges to and from any places on the river between the Albert Docks and the London Bridge vary from 21 to 25 cents per ton. Beyond the above limits the rate is 37 to 50 cents per ton, and this rate does not include the labour for unloading and loading. These charges are paid by the owner of the goods, and cover the cost of conveyance only, transport by water being much cheaper than by railway or vehicle.

XII.—Financial Situation.

The capital invested in the port of London may be stated to be as follows:—

	$
Riverside quays	65,000,000
Docks	120,000,000
River development	1,700,000
	$ 186,700,000

THE PORT OF GLASGOW.

I.—Introduction.

In the year 1773 Glasgow was an unimportant town, having less than 30,000 inhabitants. There was no harbour, the River Clyde being, in places, from 15 to 18 inches deep, and with only a "sensible" tide opposite the town. As far down as 12 miles below Glasgow, the river was fordable.

The River Clyde is now one of the great navigable highways of the world, 22 feet deep at low tide and 33 at high tide, and its construction is considered a triumph of engineering skill. The creation of this inland waterway, with the resulting commercial and manufacturing establishments, is certainly a most notable achievement.

It has been remarked in connection with the shipbuilding and manufacturing development of this part of Scotland that "navigation facilities, mineral resources, geographical situation, and Scotch grit have been the chief causes."

Glasgow, besides being now the first commercial city in Scotland, is one of the important ports of the United Kingdom, and has a population, including suburbs, of 800,000.

It was the success of the improvements on the Clyde which prompted the improvement of the River St. Lawrence Ship Channel to Montreal, which now, as regards size and navigability, so far surpasses its model.

The first dredging machinery used on the St. Lawrence was designed and manufactured on the Clyde.

The authority which has accomplished so much is the Clyde Navigation, the Trustees of which combine all the functions with respect to the river and harbour, viz.:—

Docks, construction and administration.
Pilotage.
Aids to navigation.
Ship channel improvements.

Their mottoes are, "Every consideration for the success of the Port," and "No axes to grind."

It appears, unquestionably, that their policy is one of success.

II.—Ocean Business.

Classes of Trade.

The district, of which Glasgow is the centre, is one of the most important in the United Kingdom for coal, iron, shipbuilding, machinery, and manufacturing generally. There is, therefore, a great variety of traffic in the port.

Beside the extensive river, passenger, and market business, there is the large channel and coasting traffic, the coal and ore trade, and the very extensive overseas colonial and foreign general commerce.

The harbour space occupied is approximately indicative of the business of the port:—

50 per cent regular lines.
24 " general and occasional.
17 " coal and ore trades.
9 " timber, cattle, fitting out, &c.

Types of Vessels.

One of the two largest and fastest ships in the world was constructed and fitted out in Glasgow, the Cunarder *Lusitania*, and sailed down the Clyde, drawing 29½ feet. Battleships and men-of-war of all classes are built on the Clyde. Several noted shipbuilding firms have lately removed there from England, in view of situation, cheap materials, municipal taxation, and especially on account of the skilled and reliable labour market.

The merchant vessels which frequent the port are not of the fast passenger and mails class, but more of the passengers and freight type. The Allan Line have within the last year established a service between Montreal and Glasgow of new, fairly large vessels, suitable for passengers and express freight, which is proving very successful.

The Donaldson Line, of Glasgow, also does a very large Canadian trade, carried by a fine and steadily improving fleet of freight ships having moderate passenger accommodation.

Warehousing and Stevedoring.

Warehousing is left to private enterprise.

The loading and unloading of vessels is done by the shipping firms, or by master stevedores, in both cases under license by the Trustees.

Tonnage.

The number and tonnage of vessels using the harbour of Glasgow for 1906-07 were as follows:—

Coasting.

	Number.	Tonnage.
Inwards	14,995	3,359,761
Outwards	14,320	2,156,566
Total, inwards and outwards	29,315	5,516,327

Foreign.

Inwards	1,402	2,440,530
Outwards	1,998	3,584,350
Totals, inwards and outwards	3,400	6,024,880

Coasting and Foreign.

Inwards	16,397	5,800,291
Outwards	16,318	5,740,916
Totals	32,715	11,541,207

Foreign Trading to Canada.

Inwards	142	373,737
Outwards	122	346,269
Totals	264	720,006

Number of vessels entered the port:—

Under 1,000 net tons	16,301
1,000 to 6,000 "	1,435
6,000 and over "	4

The tonnage of goods imported and exported amounted to 9,566,211.

Trade Results.

The trade results to the country and to the district, of which Glasgow is the centre, owing to the creation and success of the port, are incalculable.

As a shipbuilding and manufacturing point, it appears to be one of the mainstays of the industry and commerce of the United Kingdom, the loss of which would be heavily felt in the increasing European competition.

III.—Features of Success.

Early Development.—Glasgow is not one of the older ports. Its creation as a harbour and the development of its shipping are comparatively modern. The growth has been gradual, but steady, and much credit is due to the far-sighted policy which brought about, from practically nothing in 1775, a shipping of 1,500,000 tons in 1864, and 11,500,000 tons in 1907, inward and outward combined.

Ownership of Complete Harbour Area.—The Clyde Navigation Trustees have acquired, by grant and by purchase, the bed and banks of the river. They have purchased large tracts of land for past and future extensions. Their policy is to keep control of all features in connection with the river and harbour. There is no clash of authority or shifting of responsibility. There is only one authority.

Situation.—The success of Glasgow, as a port, is due in a large degree to her situation. The harbour is not on a line of a great trade route, but it is situated in the trade centre of Scotland.

Owing to its situation, its commerce must largely be the maritime trade of Scotland.

The harbour is situated in the heart of Glasgow. The Clyde navigation extends to, and includes, Port Glasgow, 18 miles down the river. Passing Greenock on to Gourock, 5 miles further down, the river opens into the Firth of Clyde, which makes easy navigation 60 miles to the Mull of Kintyre and there opens into the north channel of the Irish sea.

Mineral Wealth.—The district of Glasgow is noted for its mineral wealth of coal and iron, and it is known far and wide for its skilful and industrious workmen, and the mechanical genius of its engineers.

IV.—Types of Port Business.

(a) *Ocean Ship to Coasting Ship.*

A large share of the coasting trade of Scotland and Ireland centres in Glasgow, overseas commerce being received and distributed through this port. Large shed accommodation is therefore required, and facilities for unloading, and loading into all classes of vessels.

(b) *Ocean Ship to Railways.*

Glasgow not being on a trade route, but a centre of trade, there is not a large through railway business. As, however, all mines and industrial works are connected directly by railway, a very large proportion of the business of the port is handled in this way. The closest possible connection between the ships and the railway tracks is therefore necessary.

(c) *Ocean Ship to Warehouse by Carts.*

The third largest system of conveying the freight between the warehouses, stores, &c., and the ships, is by carts, and hauls are frequently quite long on account of the river intersecting the business portion of the city.

(*d*) and (*e*) Lighters or canal barges are not the rule, and most of the goods is discharged directly on to the quay.

The facilities for the handling of these types of business have been planned with care, and in the newest dock, unique appliances of a very successful and economic design were seen.

V.—Port Types.

The harbour may be classed under two distinct subdivisions:—

(*a*) Riverside quays or jetties;

(*b*) Tidal basins.

Up to a certain stage of extension, riverside quays were the natural type. This system, however, not being adaptable for extension and concentration of business, docks had to be resorted to. The first dock, the Kingston Dock, was opened in 1867; the second, the Queen's Dock, was commenced in 1870 and completed in 1880. These are really tidal basins and not wet docks, as there are no gates or locks, and the water level fluctuates with the tide, the range of which is about 9 to 11 feet.

Two other docks or tidal basins have been constructed since the completion of the Queen's Dock, viz., the Prince's Dock and the Rothesay Dock. Another, the Yorkhill Basin, is now under construction.

The proportion of wharfage accommodation for vessels is approximately as follows:—

Riverside quays	45 per cent.
Tidal basins	55 "

A large proportion of the riverside quays are available and used for smaller vessels, ferries, and market boats.

In the basins, concentration is possible, and almost all wharf space is available for large steamships.

VI.—Dry Docks.

The harbour is provided with five graving docks. Three belong to the Clyde Navigation, and the other two are in connection with private shipbuilding yards.

The three Clyde Navigation dry docks vary from 551 to 880 feet in length, and the entrance depth at high water, springs, from 23 to 26½ feet.

No. 3 dock, which is 880 feet long, and has an entrance width of 83 feet, is really double, having a pair of inside gates, making one dock 460 feet and another 420 feet long.

This was constructed departmentally, and is in itself a tribute to the skill of the staff of the Trustees.

There are no floating docks in the port of Glasgow, but there are several patent slipways of from 200 to 800 feet long and draught of from 5 to 17 feet, owned privately.

VII.—Approach Channels.

From Port Glasgow up the River Clyde, 18 miles to Glasgow, the approach channel is almost as much a canal as the Suez canal.

Regulation of the river banks and systematic dredging have accomplished the wonderful transformation of a small stream, from being almost beyond tide water and unsuitable for any sort of navigation, into a waterway for one of the important commercial ports of the world.

The average level of high water, spring tides, has remained practically unchanged up to Glasgow Bridge. Low water, however, has been lowered some 9 to 11 feet, which makes the present tidal range.

The first improvements were commenced in 1773, and consisted in works for contracting the channel and dredging, and in 1775 the depth had been increased from 1½ feet to 6½ feet.

The first steam dredging was commenced in 1824, and in 1830 vessels of 15-feet draught ascended safely to Glasgow.

Since 1844, from which date statistics are available, the number of cubic yards dredged, in the river and docks, has amounted to about 73,000,000 cubic yards.

The quantity removed during the last 10 years has averaged about 2,200,000 cubic yards per annum.

In the River St. Lawrence ship channel, since 1851, the total amount dredged has been about 54,000,000 cubic yards, and the average for the last 10 years has been nearly 3,000,000 yards per annum.

The depth of water up to Glasgow harbour is now some 22 feet at low water, ordinary spring tides, and during extremely low tides about 2 feet less. At high tide, springs, the depth is about 33 feet.

Large vessels always navigate with the tide, and in sailing from Glasgow start about two hours before high tide, and reach deep water a couple of hours after high water.

The width of the channel, which means the whole river for about 10 miles, is from 400 feet to 550 feet, the curves being all easy.

Artificial navigation extends for about 4 miles beyond the Clyde Trustees' limits, from Port Glasgow to Greenock. This is under the Clyde Lighthouse Trustees, including the lighting and buoying of that portion of the river.

The lighting and buoying of the river cannot be compared with the St. Lawrence either in regard to the number or character of these aids to navigation.

The lighthouses are small, not uniform, the buildings neither of lasting construction nor on permanent foundations.

The buoys, of almost every known shape, make good day marks, but the lighting is modest as compared with the splendid system now existing on the St. Lawrence.

The bottom of the river, except in one place, is soft, and nothing is thought of a vessel, if delayed, resting on the ground for a few hours at low tide.

Eternal vigilant watching and dredging are required, owing to the constant silting going on. Sweeping is not carried on, the depth being examined by soundings only.

As compared with the Clyde, the River St. Lawrence is magnificent. As a navigable channel, possibility of further enlargement, maintenance, lighting and buoying; and of reaching inland not only to a trade centre at Montreal, but on the great North American trade route to the North-west, both by water and rail; the River St. Lawrence ship channel is unique in the world.

VIII.—Accommodation for Vessels.

The total length of quay front in Glasgow harbour is about 10 miles.

About 50 per cent of this is devoted to the trans-oceanic trade, about 20 per cent to the coal and mineral traffic, and the remainder to general, coasting and river services.

At least 40 ocean ships may be accommodated with berths at one time, with shed accommodation.

For the mineral and coal traffic there are about 20 berths available.

The length of the main part of the harbour is about 1½ miles, and the greatest width at the docks, about ½ mile; all convenient to the business part of the city.

The widths of the piers vary from 200 to 250 feet, and the widths of the basins from 200 to 300 feet.

IX.—Port Equipment.

Sheds.—Modern sheds are the rule in Glasgow harbour. The usual position is from 15 to 20 feet back from the edge of the quay.

The type of sheds is both single and double storey. They are from 70 to 75 feet wide, the combined length being nearly $5\frac{1}{2}$ miles and the total floor area nearly 50 acres.

The appliances for exchanging cargo between the upper and lower floors, are chutes of a specially designed type, and the wharf cranes. Except in special cases for storage, the upper floors are only used for inward cargo which can conveniently be descended in the chutes. Hatches, adaptable to the cranes, are also available for heavy packages.

Cranes.—Three types are in use, steam, hydraulic and electric. All the newer cranes are electric.

In all, there are over 100 cranes in the port, besides several shore cranes with a capacity of up to 150 tons.

The equipment of the new Rothesay Dock is of especial interest. The electric power generating station, from the boilers to the large engines directly coupled to the generators of a combined capacity of 3,500 k., is of the latest design and a model of construction.

Electric cranes, capstans, turntables, coal hoists, and lighting, all of the latest patterns for the services they are intended, are installed, and all supplied with power from the generating station.

Harbour Railways.—All the principal docks are connected by rail with the various railway terminals.

The discharging and loading of ships is done under license from the Trustees, by master porters. They may be either the shipowners or stevedores, or principal consignees. Packages discharged are sorted by this authority, as received from the ship's slings, and there is a great relief in the obtaining and removing of the goods.

Among some of the regular lines, it is the practice to unload at one berth and then remove to another berth to load. The disadvantage is that loading and discharging cannot, in that case, be done simultaneously.

X.—Port Administration.

Up to the year 1825, the magistrates and the Town Council of Glasgow were the River and Harbour Authority. The first representation of the shipping and trade interests were added to the Trustees in that year.

At various times changes have been made in the representation until now the number of Trustees is 42, composed of representatives of the city and of the various municipalities adjoining the port, of the Chamber of Commerce, of the trades and of the shipping.

This is now the authority having full and complete powers and jurisdiction over the port and the river, down to Port Glasgow.

With such exclusive authority a very full and complete organization is possible, with an efficient staff and plant for the proper carrying out of the administration and construction of the port and its facilities.

All of the dredging and most of the construction work is carried on departmentally under the skilled engineers and trained officers of the Trustees.

The Trustees have borrowing power, by Act of Parliament, as well as authority for the levying of dues on vessels and goods, to pay for the cost and maintenance of the works, equipment, improvements and supervision.

Pilotage is compulsory between the Tail of the Bank, near Greenock, and Glasgow, a distance of about 22 miles. There are 26 Glasgow pilots for the outward voyage and 20 Greenock pilots for the inward trip up the river.

XI.—Port Charges.

In the port of Glasgow, 25 per cent of the revenue is derived from vessels and the remaining from cargo and other sources.

Tonnage Dues.

Vessels, except from the United Kingdom, per registered ton:—	
Inwards	0 08 cents.
Outwards	0 08 "

Rates on Goods, per ton.

Iron ore	0 06
Stone, &c	0 08
Bunker coal, grain, &c	0 24½
Timber, &c	0 30
Castings, &c	0 37
Cotton, forgings, machinery, coal products, &c	0 49

Rates for Cranes.

Wharf cranes, per day of 12 hours	4 87
Large cranes, under 70 tons, per ton	1 10
Over 70 tons	1 47

Rates for Quay Rent on Goods beyond Authorized Time of 48 hours after Discharge.

For first 24 hours	0 59 per hour.
For every subsequent hour	1 22 "

Rental of Sheds.

This is included in the above rates.

Pilotage.

From Greenock or Tail of Bank to Glasgow, or *vice versa*, 22 miles, for vessels drawing 15 feet or upwards, per foot of draught	1 45

Railways.

The handling of railway traffic being operated by the railway companies, the rates are included in the freight rates.

XII.—The Financial Situation.

The capital expenditure on the river improvements, the harbour, plant, vessels, sheds and equipment approximates to date	$44,000,000 00
The expenditure, including interest, maintenance and management for 1906–7, approximate	2.500.000 00
The capital expenditure for new works, equipment, plant, &c., 1906–7, amounted approximately to	1,800,000 00
Making an expenditure for the year of	$4,300,000 00

The revenue from all sources for 1906–7 amounted as follows:—

Tonnage dues on vessels	$ 675,000 00
Dues on goods	1,435,000 00
Wharf and coaling and mineral cranes	260,000 00
Miscellaneous	370,000 00
	$ 2,740,000 00

XIII.—Port Design and Construction.

Design.—The desigu of the harbour has in view the bringing of ocean shipping into the industrial centre of Scotland. This required the construction of a ship canal or channel, through not only soft material but a ledge of rock.

The river being very narrow, land had to be acquired and basins excavated for the making of docks, which were not enclosed by gates owing to the range of the tide being only some 10 feet.

The cost of dredging and plant and river improvements, apart from the harbour proper, represents a cost of about $20,000,000.

The design is not symmetrical, and there is no special characteristic feature, except the concentration of the general shipping business as near to the centre of the city as possible.

Construction.—Most of the construction work is carried out departmentally, and it reflects very great credit on the distinguished engineers who have designed and directed the works.

Several novel features of foundations add character and permanence to the construction.

The dry dock No. 3 is a splendid specimen of engineering skill and construction.

The new Rothesay Dock, and its equipment, is a model of up-to-date accommodation for the coal and ore traffic.

Provision for the future.—There is no reason why the river cannot be made and maintained to any reasonable increased depth. The Trustees have also had the foresight to perchase land in advance for future dock development.

XIV.—General Impressions.

The port, from which Montreal has to a great extent been modelled, is of special interest.

Without extensive river improvements, there could have been no port. The enterprise and sound judgment of some of the most talented business men of the times, have resulted in splendid success.

Although of great bneefit to the commerce of Great Britain, the value of the port to Scotland, and to the Glasgow district, is very great. The shipbuilding industry is itself of immense benefit to the British flag.

The lessons for Montreal are not ended. The growth of the industries in the vicinity of Glasgow, with the progress of development of the port, and the sound principles and energy of the people, are of the greatest possible encouragement.

SESSIONAL PAPER No. 21c

PORT OF MANCHESTER.

I.—Introduction.

Manchester, with her population of 900,000 people and her prestige as the centre of the great textile industry of Great Britain, long felt the need of an open waterway to the sea. Although her distance from the sea did not extend 60 miles, her immense business felt the strain of competitive conditions imposed by the transfer charges through the port of Liverpool and the rail haul from that point. The conception of passing by the port of Liverpool and digging out a canal 35½ miles long with a bottom width varying from 120 to 180 feet, giving a depth of 26 feet of water, soon to be completed to 28 feet throughout its entire length, was indeed a bold conception involving far-sighted business acumen, faith in the future, and enormous sacrifice.

II.—Ocean Business.

Manchester has direct ocean trade with Canada, largely due to the enterprise of Sir Christopher Furness and a group of influential business men associated with him. Grain, timber, cattle, produce, and fruit find a market of nearly 15 millions within a radius of 100 miles, and of 8,726,000 within a radius of 50 miles. She has also direct lines putting her in touch with the principal American ports, including Boston, New York, Philadelphia, New Orleans, Galveston, Savannah, Mobile. She is the first fruit port in the Kingdom, and her proximity to Sheffield, Birmingham, and other large manufacturing centres, provide the output for regular return cargoes.

Regular lines run to Canada, United States ports, as well as South America, Australia, Bombay, Persian Gulf, Alexandria, Norway, Denmark, Russia.

III.—Features of Success.

It was not until the year 1885 that the undertaking was determined. In that year, by Act of Parliament, the Manchester Ship Canal Company was formed with a capital providing an expenditure of $50,000,000. This capital, however, proved inadequate for completion and full equipment of the canal and the development of the docks, and $15,000,000 for this purpose was borrowed from the City of Manchester in 1891, and $10,000,000 more in 1893, one of the conditions being that the Corporation of Manchester be given the right of appointing a majority of the Board of Directors of the Canal Company while the loan lasted.

IV.—Types of Port Business.

(b) *Ocean Ship to Railways Direct.*

All the piers are equipped with single and double rails at the ship side, affording ample facilities for the handling of cargoes direct.

(c) *Ocean Ship to Warehouse by Vehicle.*

Under the control of the port are innumerable warehouses to which cargo is brought by means of railway cars and by horse vehicle.

(d) *Ocean Ship to Warehouse by Lighter.*

Considerable portion of the port's business is transacted by means of "pontoons" which moor alongside the ship at her berth and permit the discharging of cargo simultaneously to the quay and overside on to the pontoon. The pontoon can be towed anywhere, and affords additional storage and effects despatch.

V.—Port Types.

The canal itself is tidal for a distance of 21 miles, and there are five systems of locks, the largest of which (at the entrance at Eastham) is 600 feet long and 80 feet wide. The other large locks are 600 feet long and 65 feet wide. The smaller locks are 350 feet long by 45 feet. This canal is available for vessels as large as 550 feet by 62 feet wide, and drawing 26 feet of water. Up to the present time, however, the largest ship using the canal has been 500 feet in length with a tonnage of 12,000 tons. There is a rise of 58 feet 6 inches from the mouth of the canal to Manchester.

VI.—Dry Docks.

Two graving docks operated by an independent company, called the "Manchester Dry Docks Company," are also within the Dock Estate.

VII.—Approach Channel.

All shipping trading to Manchester passes up the Mersey past Liverpool to Eastham, where is situated the entrance to the Manchester Ship Canal.

In the first section of the canal, viz., from Eastham to Latchford, a distance of 21 miles, the increased depth to 28 feet as named above has been obtained by raising the level of the water in the canal 2 feet.

From Latchford to Manchester the process of obtaining the depth of 28 feet, including the Manchester Docks, by dredging is nearing completion. There is only a small length in the docks to be dredged, and in a few months' time there will be a depth of 28 feet both throughout the canal and in the various basins of the large docks at Manchester.

VIII.—Accommodation for Vessels.

The Manchester docks extend over an area of about 400 acres, within which is included a water space of 120 acres, a quay length of 6½ miles, and a quayage area of 286 acres.

Twenty-three miles below Manchester, at Runcorn, are further docks belonging to the company, covering an area of 70 acres, of which 15 are water.

As the entire harbour development of Manchester has been carried out since 1890, and in which the experience of other ports has been widely availed of, it stands almost unrivalled as a collecting and distributing point. For this reason the length and width of the docks, the floor area of its transit accommodation, and the nature of its equipment are particularly interesting.

The dimensions of the docks, of which there are nine, are as follows:—

	Feet.		Feet.
No. 1	700	by	120
No. 2	600	"	150
No. 3	600	"	150
No. 4	560	"	150
No. 5 (partially-constructed)	980	"	750
No. 6	850	"	225
No. 7	1,160	"	225
No. 8	1,340	"	250
No. 9	2,700	"	250

and the principal ones of these are equipped with transit sheds five storeys high.

IX.—Port Equipment.

The sheds are two, three, and four storeys high: the floors and roof are paved with asphalt; the roof, being planned to afford an extra storey, is flat. The height of the ceiling of the bottom floor is 16 feet 6 inches and the other floors 9 feet 6 inches.

Vehicular traffic is not generally done within the shed, but when space is available, with the permission of the Dock Authority, vehicles are allowed inside at stated intervals. When the shed, however, is full of cargo the vehicles remain outside and the cargo is trucked to them. On the inner side of the newer sheds is an overhang which provides protection for teams and cars alongside in bad weather.

The means of communication between the floors within the shed itself are by a system of electric jiggers, each of which raises the goods from the ground level to any of the floors and swings into any floor sufficiently for to allow the goods being deposited at the required spot from which they are trucked and sorted. There are fixed cranes at the ends of the sheds on the roof for lowering goods into cars or carts, and the roof is used for such cargoes as lumber, oil, cask freight, or anything that does not require cover. In the experience of the Dock Company it costs no more to put the goods on the upper floor or roof than it does on the first floor, and it takes no longer to discharge cargo whether placed on the roof or on the ground floor. The overhang platforms on the water and shore sides of the sheds extend 4 feet and are fitted on hinges to allow the crane slings free access to the different floors. The roof of these sheds is built to carry 30 cwt. per square yard.

The shed equipment of this port altogether consists of 37 transit sheds of which 13 are single-floor, 1 two-floor, 6 three-floor, 5 four-floor, and 12 five-floor or storeys in height. The latest types of sheds are all four storeys, including the flat roof, and are built of ferro concrete. By using this method of concrete construction, it was stated that three floors may be built for the price of two in any other method of fireproof construction.

Rails are laid in most cases two tracks deep between the shed and the water edge. This is repeated on the shore side of the shed, but in the earlier-built sheds the rails may be seen within the shed itself.

The crane equipment is—53 hydraulic, 65 steam, and 91 electric cranes with a swing of 16 to 40 feet and lifting powers of 1 to 10 tons, raising to a height above rail level of 59 feet. Pontoon sheers capable of dealing with weights up to 250 tons are also provided.

There are specially provided cold storage accommodation for beef, mutton, and special accommodation for bananas; a grain elevator, built after the Canadian fashion, with a capacity of 40,000 tons, is also within the Dock Estate. The rate at which grain may be discharged is 350 tons per hour or 12,500 bushels. This includes weighing, sacking, and loading into cars, carts, or barges. This capacity has been found to be inadequate and has been supplemented by pneumatic apparatus with a capacity of 7,000 bushels an hour.

The company also manages 13 warehouses seven storeys high of the most modern kind.

The warehouses operated by the company have railway lines on both sides and a floor space of 33,000 square yards.

The facilities for coaling ships is of the first order, one of these coaling stations, on the bank of the canal at Partington, being equipped with six hydraulic tips capable of loading 160 tons an hour each.

Cold storage accommodation in close proximity to the docks provides for 200,000 carcases of meat, and at the dock side with direct railway communication 175,000 carcases more.

The Port Authority is also vested with the powers of a railway company by statute, and own and operate altogether 132 miles of railway, 60 locomotives, and 1,500 cars. No railway company enters the Dock Estate; all are connected just outside with the Ship Canal Company's rails. The rail business on the Dock Estate is therefore operated by the Ship Canal Company, who receive for their service a portion of the freight rate charged by the different railways. The siding accommodation provides for 9,000 cars, and by this wise provision, rapid and efficient rail communication is assured over all the important British railways to every town in the Kingdom. The railway rates between Manchester and the different important trade centres reached thereby are arranged mutually between the railways and the Canal Company so as to attract business to the port.

Ships are loaded and unloaded by the employees of the Dock Company.

Manchester has also a waterway connection with the canal system of the country.

The ship's responsibility ceases as soon as the goods are out of the ship, and a penalty is charged on goods remaining on the quays or in the transit sheds longer than 72 hours.

Fire and Police Protection.

A very complete system of water patrol and land brigade organization exists, and is kept on an efficient basis.

X.—Port Administration.

The Manchester Ship Canal Board consists of 21 directors, 11 being appointed by the Corporation of Manchester. The chairman, however, is appointed by the directors elected by the shareholders. In 1904 the company succeeded in having the interest on the $25,000,000 borrowed from the corporation reduced from $4\frac{1}{2}$ to $3\frac{1}{5}$ per cent, that being the actual cost of the loan to the corporation. The amending Act of 1904 provides that for all time to come the corporation of the city of Manchester shall have the majority of the directors on the company's Board, and the $25,000,000 loan was made irredeemable and incapable of transfer.

The rates and charges are fixed by a committee, the majority of whom are directors appointed by the shareholders. The chairman, who devotes his whole time to the affairs of the company, receives $15,000 a year, and $10,000 more is divided between the 20 other directors.

The company performs the conservancy duties over the canal area. The conservancy authority over the tidal portion of the water approach to Manchester is divided between the Mersey Conservancy Commissioners, whose authority is required for any contemplated work affecting the river, the Mersey Docks and Harbour Board, the Upper Mersey Commissioners, and the Manchester Ship Canal Company.

Pilotage in the canal is not compulsory. All pilots, however, operating within the port of Manchester, which includes the Manchester Ship Canal, are licensed by the company.

XI.—Port Charges.

Ship dues are paid by vessels entering the ship canal, and are applied under three different heads according as the ship trades with section A, B, or C, into which the "Harbour and Port of Manchester" is divided.

They are further classified according to point of departure and length of voyage, and range from 27 cents per net registered ton.

Only half the specified rates are charged provided certain conditions are complied with, so that the average charge does not exceed 12 cents.

Other exceptions and variations are explained fully in the tariff issued from time to time.

A rental of 2 cents per net registered ton per week is charged after the lapse of allotted loading or unloading time prescribed by law.

Towage is also under the company's jurisdiction, and the charges are therefore regulated by tariff.

The canal company undertake to discharge or load the ships with their own men at so much a ton, according to a specially prepared rate sheet.

The company also loads and discharge the ships with their own men, and charge the shipowner therefor the actual cost of labour and superintendence, office expenses and material, and 10 per cent and 2½ per cent premium to cover liability for accident and losses.

The shipowners may requisition services of men at cost, plus 10 per cent, and work them under their own control, or pay 12½ per cent and have the work done under the canal company's foremen.

Cranes are charged for under a tariff at so much per hour.

A maximum toll is made of 25 cents per passenger.

Port Charges on the Goods, payable by the Owners.

Tolls and wharfage charges are made under a classified tariff, and are levied against the goods whether they pass over the quays or not.

XII.—Financial Situation.

The revenue of the port is raised from charges on the ship and charges on the goods, ship dues being levied according to tariff, the maximum of which reaches 35 cents per net registered ton. The company does not impose the maximum. The actual charges prevailing vary between 2 and 12 cents per net registered ton. These dues are for the use of the ship canal. All vessels entering have, in addition to the Manchester charges, to pay to the Mersey Docks and Harbour Board dues for conservancy purposes.

XIII.—Port Design and Construction.

Turning a racecourse into the most modern dock in existence does not at first sight seem an attractive proposition, yet this is what has been done, and done so well and so thoroughly that a more or less detail description cannot fail to be of interest.

DESCRIPTION OF NO. "9" DOCK, MANCHESTER, ENGLAND.

The most notable example of Fireproof Construction in England. Quay walls built on novel principle.

No. 9 dock, Manchester, owned by the Manchester Ship Canal Company, is considered the most notable example of fireproof construction in England. The transit sheds are constructed throughout of reinforced concrete, and the enclosed areas (transit sheds) have been divided by modern methods to reduce the danger from serious fire.

Dock No. 9 has been constructed on a portion of the sitt formerly occupied by the Manchester racecourse, and purchased by the Manchester Ship Canal Company in 1902. The subsoil consists of alluvial deposit—sand, gravel, and boulder clay—overlying red sandstone rock. The surface of the ground averaged

about 2 feet below water level of the docks. The new dock has, therefore, been formed partly by excavation, partly by filling, no soil requiring to be moved from the immediate neighbourhood of the dock.

Except for a short length at the westerly end, the rock was at too great a depth to be reached by the foundations. The foundations of the quay wall are carried down to the boulder clay, the foundations for the sheds down to the gravel beds lying above the clay. The maximum load on foundations is 3 tons per square foot. The length of the new dock is 2,700 feet on the centre line; width, 250 feet; depth of water, 28 feet; area of water in dock, 15½ acres; area of quays, roads, railways, &c., round the dock, 128½ acres.

The quay walls have been constructed on a novel principle, the quay being practically a long viaduct carried on arches. This was adopted—

1. As more economical under the attending local circumstances than a solid wall;

2. As it puts a vertical load on the foundations only, thus avoiding the risk of forward movement; and

3. As the water flowing between the piers affords more comfortable berthage for large vessels and reduces ranging.

The piers and arches are entirely constructed of 6.2.1 concrete formed of Portland cement and ballast obtained from the excavations, stone plums being allowed within 9 inches of the face work in the piers only.

A granite fender course, projecting 4½ inches over the face line of the piers, prevents vessels from rubbing their bilges against these latter.

The easterly end of the dock is a solid concrete wall 20 feet thick, the viaduct type of wall being inadmissible here owing to the heavy weight which will be put on the grain elevator foundations which are immediately behind this length of wall.

The face of the concrete quay wall above the fender course is composed of blue brickwork set in cement of an average thickness of 11½ inches.

The coping of the dock is of Norwegian granite, 3 feet wide by 2 feet deep. Cast iron bollards of the hook type have been fixed in the coping every 75 feet.

Behind the quay wall is a subway for hydraulic pressure, fresh-water mains, and electric cables, and behind this, for the whole length of the southerly wall and for 900 feet of the northerly quay, is a subway 9 feet 9 inches wide by 6 feet 5 inches high, for belts to carry grain direct from the ship to the grain elevator at the east end of the dock. Inlets for the grain are provided every 12 feet 6 inches, centres and centres, and it is intended to fix four belts in each subway.

The quays are provided with a crane road and two running roads, and are paved to a width of 37 feet from the quay wall with Haslingden setts.

On the northerly side of the dock is an open quay for timber and other rough cargoes.

The easterly end of the dock will be occupied by a grain elevator with a capacity of 40,000 tons, the foundations of which are already constructed. The designs of the elevator have been worked out by the John S. Metcalf Co. of Chicago.

On the southerly side of the dock five transit sheds have been erected, four 425 feet and one 450 feet in length. The total length of the sheds is 2,150 feet and the width 110 feet, each shed having four floors, including the flat roof. The area of the floor space in the sheds is about 22 acres.

The sheds are divided by a roadway 25 feet wide, and are connected by gangways between each floor. In addition, the sheds have a fire resisting partition with steel sliding doors down the middle. The height of the ground floor, 16 feet 6 inches; the upper floor 10 feet 6 inches, floor to floor. The front of the shed is closed with steel sliding doors, the back of each shed being provided with five loading-out teagles fitted with electric hoists, and all the windows are glazed with wire glass ("Mississippi" process), manufactured by Pilkington Bros., Ltd., St. Helens, Lancashire.

The loading-out teagles are carried on a verandah, enabling trucks to be loaded or unloaded under shelter from the weather.

The sheds have been constructed of reinforced concrete and were completed in 18 months; the strength of floors for a working load of 3,000 pounds per square yard tested to 4,500 pounds.

The docks and sheds are equipped with electric machinery, electric cranes being used on the quay side with jibs capable of lifting 3,000 pound loads from a vessel's hold to all the floors.

At the corner of each roof a 3,000 pound fixed electric crane is provided, and each shed has an electric hoist fitted in each of the teagles. The floors of the sheds are covered with asphalt.

The total cost of the dock was about $2,500,000.

The engineer was W. Henry Hunter; the contractors were Henry Lovatt, Ltd., Wolverhampton and London, for the docks, and Henry Lovatt, Ltd., Wolverhampton, and M. Victor Brueder, of Paris, for the sheds.

XIV.—General Impressions.

Directly following the development of the Manchester Ship Canal and the port itself, enterprising landowners saw the wonderful opportunity for attracting the investment of capital in industrial undertakings, with deep water access in addition to rail communication. The property of Sir Humphrey Trafford adjoining the canal was acquired by a real estate company, which has resold sites to the following firms:—

Morrison, Ingram & Co., Limited, sanitary engineers.
Edmund Nuttall & Co., contractors.
Sandars & Co., maltsters.
J. W. Southern & Son, timber merchants, saw mill.
Trafford Park Dwellings, Limited, cottages.
James Gresham, engineer.
W. T. Glover & Co., Limited, electrical engineers.
Trafford Power and Light Supply, Limited, electric power and light.
Morrell, Mills & Co., shipwrights.
N. Kilvert & Sons, Limited, lard refiners.
Liverpool Warehousing Co., Limited, warehouses.
Manchester Brewery Co., Limited, brewers.
Pickfords, Limited, carting agents.
Leyland, Barlow & Co., engineers.
Lancashire Dynamo and Motor Co., Ltd., dynamo manufacturers.
R. Baxendell & Son, millers.
Manchester and Liverpool District Banking Co., Limited.
Manchester and County Bank, Limited.
W. H. Bailey & Co., Limited, engineers.
British Westinghouse Electric and Manufacturing Co., Limited.
James B. Lloyd, chemical manufacturer.
Hall & Pickles, iron merchants.
Kirkpatrick Brothers, stone polishing.
Trafford Park Steel Works Company, engineers.
Thomas E. Russel, patent fireproof flooring.
R. S. Dawson, packing case maker, saw mill.
F. E. Gill, joiner and builder.
Skipwith, Jones & Lomax, Limited, engineers.
Isaac Bentley & Co., Limited, oil refiners.
General Petroleum Co., Limited, oil importers.
Homelight Oil Co., oil importers.

General Oil Storage Co., Limited, oil importers.
Williams Deacons Bank, Limited.
Co-operative Wholesale Society, Limited, bacon warehouses, &c.
Manchester Ship Canal Co., storage warehouses.
Redpath, Brown & Co., Limited, engineers.
Acme Lathe and Products Co., Limited, engineers.
H. Newsum, Sons & Co., Limited, timber merchants.
Joseph Griggs & Co., Limited, timber merchants.
The United Electric Car Co., Limited, tram car builders.
Royce, Limited, dynamos.
Baxendale & Co., lead pipe factory.
Howard Conduit Co., Limited.
William Higgins & Son, brickyard.
Lancashire and Yorkshire Railway Co.
London and North Western Railway Co.
Cheshire Lines Committee.
Illingworth, Ingham & Co., Limited, timber merchants, moulding mill.
Cooke, Laidman & Leech, Limited, timber merchants.
Imperial Lumber Co., Limited, of Toronto, timber importers.
Hovis Bread-Flour Co., Limited.
W. & R. Jacob & Co., Limited, biscuit manufacturers.
T. Hulbert & Sons, millers.
Liverpool Storage Company, Limited.
E. D. Pochin.
Key Engineering Co., Limited, conduits.
Colley & Cureton, engineers.
Trafford Park Enamelling Co.
McKechnie Brothers.
American Car and Foundry Co., railway cars.

This speaks more eloquently than words as to the policy of wise and courageous work in port development and its results.

PORT OF BRISTOL.

I.—Introduction.

Bristol's prestige as a port extends back more than a thousand years, and her merchant princes of to-day are proud to acknowledge that almost the first ocean trail blazed across the Atlantic started from the ancient city of Bristol, when John and Sebastian Cabot left its shores. It will be recalled that this trail led to the St. Lawrence River, and is still being used by the liners that ply between Canada and Bristol.

II.—Ocean Business.

The principal imports from Canada, United States, Black Sea, Argentine, and East Indian ports are grain and barley, general merchandise, wood goods, flour, meal, provisions, oil, cocoa, wines, phosphates, ores, iron, fruit, leather, and rosin.

The exports are chiefly iron goods, machinery, tin plates, chemical products, railway wagons, coal, coke, salt, spar, and manufactured oils.

As a passenger port, on the completion of the Royal Edward Dock at Avonmouth, she will be able to land passengers in London within two hours of their arrival from the sea.

III.—Features of Success.

Bristol's development has been achieved at very considerable sacrifice and cost. As early as 1803 a new course for the river was deemed necessary. For this purpose, 2½ miles of the Avon were converted into a floating harbour, at a cost of $3,000,000, with a maximum depth of 23 feet. In turning the old course of the River Avon into a closed dock, a new bed had to be found for the river. This was done, and the old waterway became a floating harbour lined with wharves, &c., affording advantageous sites for industrial development.

The port of Bristol occupies a strategic trade point, which geographically places her in, perhaps, the most advantageous position of any port of the Kingdom. Trade routes leading to Canadian (and American) ports are shorter than from London or Liverpool, while at the same time the rail haul to the centre of the Birmingham District and South Wales is 35 miles nearer the former and 141 miles nearer the latter than Liverpool.

Within a radius of 100 miles there is a population of 9,500,000, and London is only two hours away. These splendid natural advantages are largely idle as yet, but the new dock extension at Avonmouth, which is not surpassed in design and construction by any in the Kingdom, will afford advantages which cannot fail to attract shipping and through traffic.

IV.—Types of Port Business.

(a) *Ocean Ship to Coasting Ship.*

A very large coastwise business is done to and from British and Continental ports, regular coasting lines being established for this purpose.

(b) *Ocean Ship to Railway direct.*

This handling method is developing more and more, and facilities are being increased to meet the demand.

(c) *Ocean Ship to Warehouse.*

A fair proportion of the port's business is handled in this way.

(d) *Ocean Ship to Warehouse by Lighter or Canal Barge.*

Bristol's connection by inland waterway with all important canal systems makes this a popular method of enhancing distribution.

V.—Port Types.

The port consists of three different centres, the oldest of which is known as the City Docks, within the city itself, and approached by the River Avon. All three are systems of wet docks. Vessels 325 feet long with a maximum draft of 22 feet enter the Bristol City Docks, vessels with deeper draft being lightered in the Basin. These docks are considered reachable by any vessel drawing not more than 22 feet of water.

At these docks the depth of water on the sill is—

Mean spring tides	33 feet.
Mean neap tides	23 feet.

The length of entrance is 350 feet, and width 62 feet.

Portishead Docks, situated at the mouth of the Avon, have a water area of 12 acres, a quay length of 943 yards, and a shed area of 51,000 square yards. This dock is specially fitted to handle the grain and timber trade and wood goods. Twelve acres of specially equipped stacking ground for timber alongside these docks make the handling of timber rapid and economic. Five hundred and seventy-five standards of timber have been unloaded here inside of 40 hours.

Avonmouth Docks, seven miles from the city on the north bank of the river at its mouth, are the most important. Separated from the open sea by massive sea gates and lock entrances, these docks provide transhipping facilities for the largest ships, both passenger and freight.

The walls of the Royal Edward Dock have been built of concrete, lined with brick, and, with its granaries, two-storey concrete transit sheds, and their crane and conveyer equipment, together with an immense dry dock, will cost $15,000,000.

VI.—Dry Docks.

One of the largest dry docks in England at Avonmouth, with an entrance of 100 feet wide and a clear length of 914 feet, is nearly completed.

The City Docks are equipped with a dry dock 319 feet in length, an entrance of 48 feet wide and with 11 feet 6 inches of water on the sill.

There are in addition two dry docks privately owned: one 540 feet, with an entrance 52 feet wide and 14 feet 6 inches depth of water on the sill; the other 300 feet long, 57 feet wide, and 12 feet 3 inches depth of water on the sill.

VII.—Approach Channel.

The Bristol Channel is a broad clear waterway on the southwest coast of England, leading direct to the ocean. It is the estuary of the River Severn, and affords safe navigation right up to Kingroad, one mile from Avonmouth Docks, where ships of all sizes and at all stages of the tide can find good anchorage.

VIII.—Accommodation for Ships.

	Quay Length.	Water Area.	Shed Area.
	Yds.	Acres.	Sq. yds.
City Docks	4,898	83	66,230
Portishead	943	—	51,000
Avonmouth	3,277	49	150,000

This will give Bristol—

9,118 yards quay.

144 acres wet docks.

267,000 square yards shed area.

IX.—Port Equipment.

Around the City Docks at intervals are placed single and double-storey sheds, the newest type of which being double-storey, flat roofed, with cranes on the roof. The shed accommodation around these docks has an area of about 20 acres, and are approached by railway service between the edge of the shed and the water.

Net Area.		Length.	Width.	Height.	
				Ground Floor to under side of Joists.	Upper Floor to Ceiling or Tie Rods of Roof.
	Sq. ft.	Sq. yds.	Ft. ins.	Ft. ins.	Ft. ins.	Ft. ins.
Y shed.....	49,437	5,493	275 0	112 9	15 0	12 5
Z shed.....	32,778	3,642	200 0	93 0	15 0	12 5

They are equipped with electric cranes with a lifting capacity of 2 tons. Each has a flat roof upon which the cranes are erected, and on which any ordinary rough cargo can be temporarily stowed. Re-delivery from upper floors is chiefly effected by means of chutes, gantries being provided for heavy goods.

A grain elevator is also provided with a capacity of 58,000 quarters, and special warehouses have been built by the City for the reception of tobacco. These warehouses are the finest of their kind seen anywhere; one is built of stone, brick, cement mortar throughout; the other is built of reinforced concrete entirely.

The dimensions of these warehouses are:—

Net Area.		Length.	Width.	Height.
Sq. ft.	Sq. yds.	Ft. ins.	Ft. ins.	Ft. ins.
197,380	21,931	213 8	103 1	11 5 basement. 14 5 ground floor. 7 5 upper floor. 10 0 top floor.

The equipment of each consists of two electric goods lifts with a capacity of 35 cwts. each, a passenger lift, and a hydraulic press for packing purposes, and each has a nominal capacity for some 11,000 casks of tobacco.

The second one in course of construction and nearly completed will be similarly equipped.

In the first tobacco warehouse visited there was in operation a single rail man drive transporter electrically equipped, running overhead suspended from a beam, running the entire width of the ground floor and passing out over the driveway about 30 feet, enabling the taking of goods from the floor of the warehouse and delivering outside to trucks, or *vice versa*.

Hydraulic, electric, and steam cranes of different capacities line the walls of this City Dock development, and cold storage is also provided.

The grain elevator at Avonmouth has a capacity of 50,000 quarters, and is situated away from the dock, but is connected with it by an underground passage containing the conveyer belts, carrying the grain from the vessels discharging at the sheds.

Each double-story shed will have six movable cranes with a capacity of a ton and a half each.

Railways will completely surround the dock, leading to an extensive shunting yard for the sorting of freight.

Special fruit warehouses have been erected to take care of the West Indies banana trade. From nothing in 1901 this trade now keeps busy a regular line of steamers with a weekly cargo of 31,000 and a season's business of 1,625,000 bunches.

General warehousing facilities afford over 19,000,000 cubic feet of storage close to the docks.

The Severn Canal system connects Bristol inland with the waterways of Great Britain.

Railways within the Dock Estate are operated by the Dock Authority.

X.—Port Administration.

The controlling authority of the port is vested in the Corporation of the city of Bristol, and the docks are all owned and managed by the Corporation, under a committee of 19 members elected annually.

The Corporation is also the authority for the lighting and buoying of the river and approaches.

Pilotage is compulsory, and is in the hands of a committee of the Corporation, to which shipowners and pilots are elected.

XI.—Port Charges.

Charges against the Ship.

The charges against the ship consist of tonnage dues on vessels entering the port, and range from 25 to 26 cents per registered ton for vessels trading with foreign ports, including the Mediterranean Sea, to 10 to 18 cents per registered ton from other European ports.

Vessels using the transit sheds pay 2 cents per ton of cargo intended to be discharged additional, and in addition any vessel remaining in the docks longer than one lunar month pays 2 cents per registered ton per week for the first month, and 4 cents per registered ton for every week thereafter.

Charges against the Goods.

With the few exceptions pointed out in the tariff, dues on goods are payable according to the two following classifications:—

Class I.—All articles of foreign growth or importation direct from foreign or brought coastwise.

Class II.—All articles of British origin or manufacture brought coastwise.

And range from 2 cents per ton to $1 per ton.

Outward rates as per tariff are separated into foreign and coastwise, and vary from 2 cents to 30 cents per ton.

The charges on the ship are payable on entry within the port; on goods inwards before the landing thereof, and on goods outward before the shipment.

XII.—Financial Situation.

The investment of capital in the development of the port by the Corporation amounts to $27,500,000.

The revenue for the year ending 30th April, 1907, was $1,170,000, of which $315,000 was from tonnage dues on ship, $175,000 from dues on goods from foreign ports, and $60,000 from dues on goods from coastwise ports. The expense of working amounted to $765,000, leaving $405,000 to meet the interest charges.

XIV.—General Impressions.

When the Royal Edward dock is opened early in 1908, special facilities will be offered to induce the large passenger lines to frequent the port, and it is expected that in the near future these facilities will recommend themselves to both railways and steamship companies.

The fact that the Great Western, Midland, London and North Western, London and South Western Railways have direct access with the Bristol City Docks, while the Avonmouth Docks are in immediate communication with the Great Western and Midland Railways, ought to be the means of developing traffic arrangements for the handling of through business that will keep the new docks at Avonmouth busy, and Bristol will be in a position to take care of it economically and with despatch.

PORT OF CARDIFF.

I.—Introduction.

Cardiff, the great coal port of Wales, is situated at the head of the Bristol Channel on the eastern bank of the River Severn.

Population, 175,000.

II.—Ocean Business.

In 1894 the number of vessels using the port was 9,907.
In 1904 " " " " 8,483.
In 1894 the net tonnage was 4,428,436 tons.
In 1904 " " " 4,290,706 "

III.—Features of Success.

A commanding position on the open sea, harmony of control, enlightened management, together with her proximity to vnst coal areas, have combined to make Cardiff the lnrgest exporting port for Welsh coal in the Kingdom.

IV.—Types of Port Business.

The principal imports of Cardiff are iron ore, pig iron, timber and deals, pit wood, grain and flour, general merchandise, the total of which in 1906 amounted to 2,108,000 tons.

Her exports consist of coal and coke, patent fuel, iron and steel rails and general merchandise, of which she exported in 1906, in round figures, 11,000,000 tons.

V.—Port Types.

The port of Cardiff is a wet-dock development exclusively, owing to the great range of tide prevailing in the Bristol Channel.

The depth of water in the different docks ranges from 13 to 32 feet, there being—

8,800 feet of 13 feet to 19 feet depth.
9,360 " 25 "
15,000 " 32 " to 37 feet depth.

The length of entrance lock ranges from 152 to 850 feet, and the width of these locks varies from 36 to 90 feet. The depth of water on the lock sills at low water ranges from 2 feet to 15 feet 6 inches; at high water from 18 feet 9 inches to 32 feet.

VI.—Dry Docks.

Thirteen dry docks serve the business of the port, the largest of which is 600 by 60 feet wide, and the depth on the blocks at high water is 27 feet.

VII.—Approach Channels.

As Cardiff is practically approachable from the open sea through the Bristol Channel, the length and width of the channel are practically unlimited. The depth, however, at the entrance channel leading to the docks at low water is only 2 feet, and the range of tide between high and low water is 36 feet.

The tide runs from $3\frac{1}{2}$ to 4 knots.

The river bed is sand and mud, which silts on the locks at the rate of $\frac{1}{4}$ inch each tide.

Dredging of the entrance channel is under the control of the Cardiff Railway Company and is constant.

VIII.—Accommodation for Vessels.

The development of the harbour dates from 1839, and now has a water area of $161\frac{1}{4}$ acres, and a total length of quays of 35,630 feet or $6\frac{3}{4}$ miles.

In addition to the above-described dock development there are 24 acres of timber ponds with a depth varying from 6 to 8 feet.

IX.—Port Equipment.

The port of Cardiff, tapping as it does the immense Welsh coal areas, has become practically an exporting port for coal, and there are 60 fixed and movable cranes specially built for the purpose of handling efficiently and economically this business. The cranes have a capacity of 350 tons an hour. Such is their efficiency that 6,700 tons have been loaded into a single steamer in 11 hours.

The method employed is a system evolved and patented by Messrs. Lewis and Hunter of Cardiff. Each car load of coal is automatically tipped into the cage carrying 10 tons. This cage is lifted bodily by the crane and lowered into the hold of the ship, where, by further mechanical contrivances the bottom of the cage, which is conical, slips down, and the weight of the coal goes out in four different directions, practically trimming itself in the hold. Through this method of handling, the coal does not undergo breaking up in the loading and preserves very largely its quality and form. The claim is made that this method of handling Welsh coal, as compared with other methods, saves at least one-third its efficiency as fuel.

Although Cardiff is now principally an exporting port, it is also the home headquarters of the London and North Western, Great Western, Midland, and Taft Railway Companies, all of which have access to the railway development on the docks consisting of 120 miles of track, the railway department of the Bute Docks Company operating 29 engines to take care of this dock traffic.

Cardiff, however, is planning to do a more extensive general business, and for this purpose certain transit sheds and warehouses have been provided alongside the docks. These transit sheds are of two types, single storey and double storey, are about forty feet away from the ship, with four lines of railway between the shed and the water, concrete floors and foundations, corrugated iron sides and roofs, with light structural iron trusses and skylights of glass; floor level 3 to 4 feet above the ground. Team traffic is served at the ends of the sheds only, no teams coming into the sheds. The double-storey sheds have wooden floors, the upper storey accommodating flour, lard, lumber, bacon, and fruit; openings in the floor every 20 feet in two rows for sliding down the cargo from the upper storey. Large hydraulic cranes on the water side between the shed and the ship for handling cnrgo from ship to shed and vice versa.

Loading of cargo from the upper storey was witnessed, and the only means used were ordinary wooden slips. Other handling devices on the quay consist of heavy hydraulic cranes and capstans for moving the cars.

The Dock Company furnish their own light, their own hydraulic power, and have trackage accommodation for 20,000 cars at one time. There is a limited cold storage area with 125,000 cubic feet, and some accommodation for cattle and chilled beef.

Cardiff prepared itself to take on the cattle trade and develop it, building cattle lairs and chilled floors for meat, and tried it for three years without success. Canadian cattle were too young and not matured, and unsuitable for the British trade. Baltimore cattle were also tried, but without accomplishing the desired end, the reason being that Liverpool competition in dead meat was too severe.

Cardiff has a splendid communication with all the railways of Great Britain.

The ship's responsibility ceases when the goods pass the ship's rail. Ships are loaded and unloaded by cranes owned by the Cardiff Railway Company, and by stevedores under their employ.

In the case of pit wood, which is used for propping up the galleries in the coal mines, most of which comes from Sweden and France, in lengths of 6 to 12 feet and 3 to 6 inches through; this is discharged by labour employed either by consignee or shipowner under special agreement.

X.—Port Administration.

The dock development has been the result of the investment of private money, the entire docks at Cardiff being under the control and management of the Bute Docks Company, being the property of the Cardiff Railway Company since 1879, in which the Marquis of Bute holds the controlling interest.

The lighting and buoying of the channel is carried out by the Cardiff Railway Company.

Pilotage is not compulsory, but is under the control of a separate board, consisting of representatives appointed by the Cardiff Corporation, the Cardiff Railway Company, Shipowners, Canal Company, and two other railways.

XI.—Port Charges.

The charges against the ship consist of tonnage rates on all shipping varying from 1½ cents to 18 cents per registered ton, according to the size of the vessel and the length of its voyage.

In addition to these tonnage rates payable on shipping, there is a further charge made for vessels remaining at the dock for a longer period than 14 days, at the rate per ton per week for the first seven days of 2 cents, for the second seven days of 1½ cents, and for every week beyond the second week 6 cents.

The use of barges can be had at the rate of 8 cents per ton

Towage rates within the dock on vessels of 50 tons burthen to 2,000 tons burthen range from 90 cents in the first class to $16.75 in the latter, and 90 cents for every additional 100 tons or part thereof.

Wharfage rates are levied against the goods and range from 6 cents to 60 cents per ton.

Terminal charge is made under a regular schedule of rates per ton. All coal, however, is moved free, the tariff charges being against general cargo only. The total rail rate is charged and collected by the railways, including the terminal rates, and the Railway Clearing House in London refunds the proportion to each.

XII.—Financial Situation.

The amount of money invested in the development of Cardiff Docks cannot be accurately ascertained, but the capital of the Cardiff Railway Company controlling these docks is $35,000,000, and the Queen Alexandra Dock, which has lately been constructed by money specially borrowed, cost $11,250,00 .

PORT OF NEWCASTLE-ON-TYNE.

I.—Introduction.

"Bringing coals to Newcastle" has become a familiar proverb. In actual practice, however, *the coals have brought the business;* the huge coal areas extending for miles beneath the hills that slope to the river are responsible for the development of the port.

II.—Ocean Business.

It is visited annually by 14,455 vessels, with a net registered tonnage of $11\frac{1}{4}$ million tons.

As a shipbuilding port it rivals Glasgow, and sends its products to all parts of the world, while as a port of call for coal supplies it is conveniently situated, with access to the North Sea.

III.—Features of Success.

The development of this river power, which had its beginning in the early fifties of last century, is particularly interesting. The administration of the port by the Corporation of the town of Newcastle, whose control over the River Tyne for centuries had retarded development, was the cause of a new authority being brought to life by Act of Parliament. From the 12th century the town of Newcastle was the sole authority of the port, and held its destiny in unbroken control until the year 1850. During these centuries, however, the Corporation failed to realize the possibilities that lay hid in the small, narrow tortuous reaches of the river. They were content to place on record as their policy the maintenance of the river in its natural condition, and felt convinced that their duty had been accomplished when they prevented it from getting worse. Their action during hundreds of years stands out in bold relief with what has been accomplished during the last half century under enlightened and continuous administration by the present Commission and their predecessors.

The depth of the river on the bar in 1723 was 7 feet at low water and 21 feet at high. In 1813, nearly a century later, the depth was recorded as 6 feet at low water, and a minimum depth in the fairway channel to Newcastle of 4 feet at lowest tide. The Corporation of Newcastle had, therefore, accomplished in 100 years the astounding work of lessening the minimum depth of the channel by several feet. This fact, and the energy of the people on the Clyde in developing their river by steam dredging, prompted the people of the Tyne to wake up, as an immediate consequence of which the present organization of the port came to life.

The largest class of vessel using the Tyne in 1850 did not exceed 400 tons register, and the problem that faced the new Commissioners 50 years ago was the task of laying down a design of river improvement that would permit the vast wealth of the neighbouring coal areas, long worked for little else than home use, to be made available for shipment to all parts of the world. They set themselves resolutely to the task, and worked out a scheme whereby the River Tyne has practically been turned from an insignificant shallow stream into a river of commanding importance among the waterways of Great Britain. To do this the river itself had to be widened, the enormous curves in it modified, the obnoxious points removed, and the banks retained by massive walls of masonry and timber wharves, the cutting of an entirely new channel and the formation of training walls to guide it. To protect the entrance of the river two long crescent-shaped masonry arms stretch themselves out into the North Sea, one of these piers being nearly a mile long, and the other considerably more than half a mile long, leaving an opening into the harbour between the two pierheads of 1,100 feet wide.

Some idea of the enormous difficulty of building sea walls to withstand the violent storm and water pressure may be inferred from the fact that the foundation stones of these piers were laid in 1854, and the piers completed only in 1895, the total cost of this protective work at the mouth of the river alone amounting to $7,500,000. The seaward end of the north pier has been entirely reconstructed since 1899.

Newcastle stands about midway between the mouth of the River Tyne and the inland limit of the Port Authority's jurisdiction, 19½ miles from the North Sea.

IV.—Types of Port Business.

Shipbuilding, coal, export, and a general cargo and timber business are all handled with the latest appliances.

V.—Port Types.

There are no jetties or piers into the river. All the development is that of wet docks, riverside quays, and tiers of moorings or water berths similar to those in Hamburg and Antwerp, which provide water moorings for the vessels. As many as nine abreast were seen moored.

Each of these moorings consists of two floating cast-iron buoys so many feet apart according to the length of berth required, connected by means of mooring chains to screws let into the bed of the river. They are practically stationary and do not drag. The top portion or floating buoys, however, may be removed at will. Ample mooring accommodation is thus provided by the Commissioners for all vessels entering the river and requiring it.

In addition to the river development itself there are several wet docks or tidal basins, with an entrance from the Tyne.

Belonging to the Tyne Improvement Commission—

Albert Edward Dock, 22½ acres in extent, situated near the entrance of the river, and well equipped with steam and hydraulic cranes and a jetty, provided with warehouse and other storage accommodation for all kinds of merchandise.

Northumberland Dock, 50 acres in extent, well equipped with steam cranes and spacious warehouses for the storage of merchandise.

Belonging to the North Eastern Railway Company—

Tyne Dock.—Water area 50 acres in extent (exclusive of timber ponds). Tidal basin, 10 acres. Situated near the entrance of the river.

Staith Accommodation for Coaling Vessels—

Albert Edward Dock Staith, belonging to the Tyne Improvement Commission.

Whitehill Point Staiths (5 in number), belonging to the Tyne Improvement Commission.

Northumberland Dock (11 private staiths).

Tyne Dock Staiths, belonging to the North Eastern Railway.

Dunstan Staiths, belonging to the North Eastern Railway.

Many private staiths in the river.

Timber Ponds—

Belonging to the Tyne Improvement Commission, Jarrow Slake, 76 acres in extent.

Belonging to the North Eastern Railway Company, Tyne Dock, 35 acres in extent.

Quays—

North Shields (belonging to the Tynemouth Corporation).
South Shields (belonging to the South Shields Corporation).
Newcastle Quay (belonging to the Newcastle Corporation).
Gateshead Quay (belonging to the Gateshead Corporation).
And others.

VI.—Dry Docks.

Being a shipbuilding port there are innumerable dry and floating docks owned by private firms or companies, the largest of which has a 90-foot entrance, is 675 feet long, and has a depth of 28 feet.

VII.—Approach Channels.

The port of Newcastle, with its population of 200,000 souls, is situated 12 miles from the North Sea, on the River Tyne.

The River Tyne is navigable from Hedwin Streams to the North Sea, a distance of 19½ miles. It has a channel depth varying from 25 feet at low water to 35 feet at high, and the approximate widths of the channel vary from 150 feet at Newburn to 700 feet at Shields Harbour.

The following lighthouses mark the harbour and river:—

High and low lighthouses (North Shields).
North Pier lighthouse (85 feet high).
South Pier lighthouse.
Groyne lighthouse.

The whole of these lighthouses are under the control of the Commissioners, who are the lighting and buoying authority of the port.

The range of tide varies from 14 to 15 feet at ordinary springs.

The river bed consists of soft sand and mud with stretches of solid rock.

An enormous amount of dredging has been required to bring about this wonderful transformation in the river itself. From the year 1850, when the river depth at the bar did not exceed 6 feet at low tide, up to the end of 1907, a total of over 120,500,000 tons had been raised by dredging, towed out to sea, and deposited far enough from the entrance to prevent of its ever becoming a menace to navigation.

To carry out this dredging the plant in use has been—

6 ladder dredges.
8 tug boats.
13 steam hopper barges.
24 dummy hopper barges, and other craft.

And the cost to date of the dredging alone of the River Tyne amounts to about $13,750,000.

VIII.—Accommodation for Vessels.

Both the riverside quays, water moorings, and docks afford ample accommodation for vessels to lay up.

IX.—Port Equipment.

The docks are all supplied with cranes, coal staiths, or pier-heads for the shipment of coal. The coal for the Commissioners' staiths is brought down in cars by locomotive or hydraulic capstan from the standage sidings on to the staith-head, and from thence automatically to the tipping point. The empty cars return automatically from the tipping point along empty wagon sidings provided for the purpose.

Each car, fitted with a hopper, is received at those staiths of the Commissioners which are fitted with hydraulic hoists at the tipping point into a hydraulic cradle, which is elevated and the coal teamed into the hold of the vessel through a steel spout at the rate of 500 tons an hour. The Commissioners' staiths so fitted are specially built for loading at great heights.

Grain warehouses and general receiving depôts for mixed cargoes are also provided. The grain warehouses are privately owned and controlled, and there are 14 large warehouses and sheds for the storage of grain and other cargoes.

X.—Port Administration.

The Port is under the jurisdiction of a Commission, called the Tyne Improvement Commission, consisting of 2 life Commissioners, 15 Commissioners elected by Corporations from the different Tyne ports of Newcastle, Gateshead, Tynemouth, South Shields, and Jarrow, and 15 elected by the payers of Tyne dues representing the shipowners, coalowners, and traders.

In addition to possessing authority over the river traffic, this Commission also is the owner of docks and staiths enumerated above, the river police and fire authority, the lighting authority, the owner of three ferry services, and wrecking authority within the limits assigned it under the original Act of 1850 and subsequent Acts.

The Chairman of this Commission is Sir William Haswell Stephenson; the Secretary, Mr. J. McDonald Manson; the Chief Engineer, Mr. James Walker.

The Trinity House of Newcastle-on-Tyne has three representatives on the Commissioners' Committee, which deals with the lighting of the port.

Pilotage is under the control of the Tyne Pilotage Commissioners, and is not compulsory.

XI.—Port Charges.

Charges against the Ship.

The revenue of the port is derived from 13 different classifications of rates and dues levied as follows:—

Pier rates, tonnage rate for moorings, river tonnage rate, ballast dues, River Tyne export dues.

1. Pier rates vary from 2 to 4 cents per registered ton and are paid by the ship.

2. Tonnage rate for moorings ½ cent per registered ton charged against every vessel receiving, discharging, or delivering cargo within the port.

3. Additional rates for using the moorings after first eight weeks of ½ cent per registered ton per month during the next succeeding four months, and 1 cent for each month or part of month beyond this period per registered ton.

4. Ballast dues against the ships loading or discharging solid or liquid fuel or ballast from 2 to 4 cents per registered ton.

5. River tonnage rate of 3 to 6 cents per registered ton.

6. Ballast dues for conveying or receiving ballast within the port, 33 cents per ton.

Ballast conveyed to sea, 37 cents per ton.

7. Dues on vessels entering or leaving the port without receiving or delivering or discharging cargo, 5 cents per registered ton.

8. Bridge dues on every vessel passing either way through the opening or swing bridge, 4 cents per registered ton.

9. Dues on river steamboats $1.00 per horse power per annum for towing vessels or vessels carrying local passengers or goods.

10. Harbour light dues range from 22 cents to 35 cents on every vessel leaving or entering the port according to the tonnage.

11. Buoys and beacon dues from 8 cents to 31 cents for every vessel entering or leaving the port according to the tonnage.

12. Export dues $2\frac{1}{2}$ cents on every ton of coal cinders or coke carried.

Charges against the Goods.

Dues on goods are paid according to published tariff, and vary according to classification.

XII.—Financial Situation.

The expenditure by the Tyne Improvement Commissioners in the river and dock improvement at the end of 1907 amounted to nearly $83,500,000.

The total revenue of the Tyne Improvement Commissioners for 1907 amounted to over $2,186,000.

XIII.—General Impressions.

The Commissioners are proceeding to create a still deeper waterway, and on the 8th January, 1903 determined, on the recommendation of their engineer, Mr. James Walker, to continue deepening the channel so as to ultimately obtain a minimum of 30 feet at low water instead of 25, their policy being to dredge the river to a depth in advance of the size and draft of vessels frequenting it.

The River Tyne, through the foresight and energy of the Commission established in 1850, has made possible the launching of the greatest battleships and the greatest transatlantic liners built in the world. From a river narrow, tortuous, and full of navigation difficulties with a depth of 6 feet, it has been changed into a broad commercial avenue of trade permitting the launching of the mammoth "Mauretania" from the yards of Messrs. Swan, Hunter and Wigham Richardson, Limited. The river from Hedwin Streams to the sea, a distance of $19\frac{1}{2}$ miles, has become a main thoroughfare on whose banks have been built up a continuous industrial development hardly rivalled the world over. Among these great industrial works are the famous shipbuilding and armament works of Sir W. G. Armstrong, Whitworth Company., Limited, at Elswick.

The investment of so large an amount of money in protective and development works on the river has, however, been amply justified by the great development in the port's business, which principally consists in coal for export and timber for import. Last year's, 1907, export of coal amounted to 17,850,000 tons.

This import and export business of raw material is of course aside from the tremendous industrial development that has sprung up almost throughout the entire length of the navigable portion of the river. The shipbuilding yards of Messrs. Swan, Hunter and Wigham Richardson, Limited, established on the Tyne are among the most important in Great Britain, as are also the huge steel armament works of Sir W. G. Armstrong, Whitworth Co., Limited, at Elswick.

Both banks of the river are lined with industries, the chief among these being the following:—

1. Shipbuilding.
2. Ship repairing.
3. Chemical manufactories.
4. Cement manufactories.
5. Ordnance works.
6. Lead works.
7. Brick works.

8. Paint and colour works.
9. Chemical manure works.
10. Creosoting works.
11. Iron and steel manufactories, engineering and boiler-making shops.
12. Timber yards and saw mills.
13. Corn mills.
14. Blast furnaces.
15. Hemp and wire rope works.
16. Grindstone manufactories.
17. Potteries, &c., &c.

PORT OF HAMBURG.

I.—Introduction.

Hamburg is situated on a tidal river, 76 miles from its mouth, the farthest inland ocean navigation point on the River Elbe. Meeting this ocean traffic is a canal and river system of water distribution. Main lines of railway running throughout the German empire also converge here, making the study of her development very interesting from her likeness in point of situation to the port of Montreal.

The German empire, in Europe, is a confederation of states or provinces, each presided over by a local government.

Hamburg is one of these states, and not only includes the city but a surrounding area of considerable extent.

The city has a population of 850,000, and until 1888, when she joined the German Customs Union, was the largest of the towns belonging to the Hanseatic League.

In the 13th century an alliance of the great commercial towns of North Germany was formed, which has since been known to the world as the Hanseatic League. The object of this association was to protect German trade against Danish enterprise in the Baltic Sea. This League, ostensibly formed for trade purposes, only made war against Sweden and Denmark, and garrisoned several important places in those countries, becoming so powerful at the end of the 14th century that it actually elected the King of Denmark. Eighty cities were included in the Hanseatic League from Revel to Amsterdam, and Cologne to Cracow. With the rise of English sea power, and the creation of new commercial relations between Europe, Amercia and Iadia, the prestige of the League declined.

Towards the middle of the 13th century Hamburg's prosperity began to return, largely due to the enterprise of her citizens and the establishment of direct communication with America.

Beginning with the year 1881, a settled purpose makes itself manifest in the steps that were taken to establish a great world port, and for the seven succeeding years enough land was quietly acquired by the state to carry out its plans. Whole districts containing streets, warehouses, dwellings, &c., were expropriated in anticipation of this development.

II.—Ocean Business.

Being the distributing point for a large over-ocean trade, the business coming to Hamburg by ship comprises nearly all the articles known to commerce. The Hamburg-American Company, one of the largest and most influential shipping companies in the world, finds its headquarters here and occupies a considerable

part of the harbour exclusively for its own business. All types of vessels trade with Hamburg.

The number of vessels entering the port of Hamburg has increased from 13,000 to 15,000 in five years, and the tonnage in the same time from 8,000,000 to 11,000,000 tons. In addition to this, the inland trade amounts to 8,500,000 tons a year, and the tonnage of the vessels discharging at the mooring buoys in the stream is said to be two-thirds of that discharged at the quays.

The ownership of the port, so far as the wharves, transit sheds, and terminals are concerned, is vested in the state of Hamburg, which is also the authority for the dredging and maintenance of the navigable channel, the annual cost of which within and without the docks, including the expenses of maintening the dredging machinery and plant, amounts to $225,000. The plant now in service consists of six dredges from 85 to 750 tons. The material dredged has to be taken away a distance of 6½ miles, and the annual amount dredged during the last 10 years has been 1,140,000 cubic metres.

III.—Features of Success.

The state owns the entire harbour area outright, and has provided considerable reserve areas for future development.

The bounties offered by the German government for the cultivation of beet root, producing as it has large quantities of beet-root sugar, sends to Hamburg a large part of its exports, which are carried away in ship-loads to other countries. This, together with the great increase in manufactured products destined for foreign markets, provides a large part of return cargoes leaving the port.

Auxiliary Port.

Two special features in the scheme of development stand out as peculiar to the port; the first is the establishment of an auxiliary port, 56 miles away, at the mouth of the River Elbe, for the express accommodation of deep-draft Atlantic liners, whose size prevents their coming up the river without first discharging a portion of their cargo to reduce their draft.

Free Port.

By far the most important feature, however, in the port's development consists in its free customs harbour or bonded warehouse district. This free harbour is cut off from the rest of the water area by floating palisades in the river itself, and the customs canal on the city side. Into this harbour vessels come and go, discharge their cargoes in part or whole into the warehouses with which it is provided. These geoods may be remanufactured and reshipped out again to foreign countries without the application of a customs tariff, or may remain in store until wanted within the German empire, and upon which the duty is only paid when delivery out of the customs district is made. In the case of reshipment inland by canal or river barge, this customs duty is paid at the point of destination. Ships may be extensively repaired within this free district, employing home-made material and home labour without the exercise of the German customs tariff. This has made it possible for Hamburg to become a collecting port for distribution of large cargoes all over Europe, and the advantage of being able to store whole cargoes and redeliver in small parcels to suit customers and destination has created a very valuable additional harbour business.

Warehouses.—The warehouses within the free port have been built by a private corporation known as the "Freeport Warehousing Company," with the state of Hamburg as a partner, the state also taking part in the administration

and a share in the profits. The warehouses have been built, however, and are maintained by the company, who operate them under regular rules and tariff, having leased from the state for 50 years the ground on which they stand. At the end of 50 years the state has the option of becoming the owner of them.

In the free port district warehouses of modern type line the water inlets leading to them. They are built of stone and brick, rest on pile foundations, and range from 6 to 12 storeys high. Into these is possible the direct removal of cargoes which have first been deposited in the quay sheds, there sorted and lightered to the warehouses.

IV.—Types of Port Business.

(a) *Ocean Ship to Coasting Ship.*

A very large and extensive grain trade is done in Hamburg from the Baltic ports in coasting vessels, or is shipped from the large liners bringing grain from the Argentine and America into small coasting ships for distribution to other ports. The Hamburg-American Line themselves own several improved pneumatic floating elevators for purposes of this trade.

(b) *Ocean Ship to Railways direct.*

As all the railways leading to the port are owned by the state, this puts under one single control the port, the canals and the railways. In her development Hamburg has provided railway communication of the most modern type to and from the piers in the harbour, all of which is being more and more appreciated by merchants and shipowners.

(c) *Ocean Ship to Warehouse by Vehicle.*

Only a small amount of carrying trade is done from ship to warehouse by vehicle.

(d) *Ocean Ship to Warehouse by Lighter.*

A very large proportion of the port's business is handled from ship to warehouse by lighter. The splendid warehousing development lining the different water approaches to the harbour makes this a very desirable and economic method of handling goods.

(e) *Ocean Ship to Canal Barge.*

One thousand four hundred inland craft and 5,000, river barges are devoted to this trade, which is growing every year in favour, much increasing the efficiency and despatch of the port.

The barge traffic of the port is among its prominent features. There are as many as 5,000 of these barges varying from 100 to 1,500 tons, owned by private individuals or shipping companies. Against these barges no charges are imposed.

About 22 per cent of the port's business is done by rail, 40 per cent by river boats, 10 per cent by inland waterways and about 25 per cent on to cars through the different sheds.

V.—Port Types.

Hamburg is a tidal basin port, all her berths being approachable direct from the river without the necessity of locking in. This character of development

has been decided upon no doubt on account of the range of tide not exceeding 6 feet, and while there are gates which separate the different parts of the harbour all the basins have free access to the river.

The wharves used for sea-going traffic are nearly all equipped with sheds for depositing, collecting, distributing and despatch of cargoes.

From the harbour, stretching out through different parts of the city, are a series of small waterways running direct to innumerable warehouses and factories. This affords one of the cheapest means of transport, and facilitates the distribution of the large warehouse merchandise from time to time.

VI.—Dry Docks.

Hamburg possesses only one graving dock built as a basin out of masonry, having adopted floating dry docks, of which she possesses 11, the largest of which now takes a 17,000-ton ship. Another floating dry dock is under order of 35,000 tons capacity. The description of docks here follows, and all of them are owned and operated by private individuals or corporations.

Name of Owner.	Length over all.	Breadth at Entrance.	Depth on Sill at High Water, Ordinary Springs.	Remarks.
	Feet.	Feet.	Feet.	
1. Blohm and Vofs (floating)	320	52	18	To lift 4,000 tons.
2. " " "	355	52	18	
3. " " "	Dimensions not known, but not large.			
4. " " "	560	88	30	To lift 17,500 tons. Can be sunk in ten minutes and raised in fifteen minutes: can be towed to Cuxhaven.
5. Hamburg American Steamship Company	400	50	18	
6. P. Wincke	260	50	14	
7. A. G. Stulckin (floating)	269	39	13	
8. " "	210	45	14	
9. Reiherstieg Company (floating)	330	85	20	To lift 5,000 tons.
10. Brandenburg (floating)				To lift 3,600 tons.
And at Altona, Rode Brothers (floating)	150	41	17	To lift 600 tons.
And six patent slips for vessels from 400 to 1,150 tons.				

There is no tariff of charges for the use of the docks, the remuneration for their use being fixed by private arrangement as circumstances warrant.

Repairing Shops.—In connection with the floating dry docks are well equipped repairing shops, all necessary appliances for repair work to ships, also under private authority and management.

VII.—Approach Channels.

The channel of the River Elbe may be said to begin at Cuxhaven, 56 miles below Hamburg proper, and is stated to have a minimum width and depth at low water of 650 feet and 26 feet respectively. The range of tide is spring 6·16 feet, neap 5·80 feet, and the flow of the river averages 4 miles per hour.

The bed of the river is principally sand, and there are numerous bars collected at different points between Hamburg and the sea; upon one of these, off Schulau, the mean low water depth is 16½ feet in the navigable channel.

The larger vessels of the Hamburg-American Steamship Line unload part of their cargo at Cuxhaven, and all the largest vessels have to wait for high water before entering Hamburg.

From time to time the navigation of the river is made difficult by ice floes in the river, when the pilotage rates are doubled and ice-breakers are employed.

VIII.—Accommodation for Vessels.

The harbour of Hamburg has room for 450 sea-going vessels, and consists of a series of ten tidal basins, which, together with the remaining area of water in the harbour available for sea-going ships, cover a total superficial area of 332 acres. River craft have an additional area of 132 acres, and the small canal and inlets leading to different parts of the town amount to 485 acres more. Three new basins are being built with an additoinal water area of 133 more acres, making a total water acreage in the harbour of Hamburg of 1,082 acres, and the quay mileage for sea-going ships is in round figures fifteen miles. For river craft and light draft vessels there are seventeen miles of wharf accommodation more.

In addition to the piers and shore wharves lining the different basins are parallel rows of water berths or anchorage dolphins, consisting each of a group of fifteen wooden piles driven into the bottom of the basin and firmly chained and anchored together. These rows of water berths take the largest ships, and ships tying up at these dolphins pay no wharf dues.

This system doubles the berth accommodation of the port.

IX.—Port Equipment.

Shed Accommodation.—The sheds are all one-storey sheds of cheap wooden construction, about 130 feet wide and varying from 360 to 1,000 feet in length, standing on piers, the quay walls of which are sixteen feet above the level of low water. The floor level is about four feet above the quay pavement. The length of all these quay sheds is six miles, and they enclose an area equal to eighty-two acres. The sheds are so built as to be high and light and are made to burn. From without they look like a three-storey shed. They are invariably set back from the water side, there being room between the quay wall and the shed for railway tracks, driveway, wooden platform, or a combination of the three. The sheds are wooden, with corrugated iron sides, with iron plate alley ways at regular intervals running at right angles to each other, upon which the trucking is done. The goods are sorted to mark, each post of the shed being numbered with a small black disc with white painted figures. The name of the consignee and the place of departure in the case of imported goods and the point of destination in the case of exported goods are written in white chalk letters on a blackboard sign suspended from a wire so that each lot of goods can be quickly and easily found.

The electric light and power wires run along the roof of the sheds at either side conveying power to the cranes and the light to the lamps.

There is no fire protection of any kind, no hose, no hydrants, no water. In justification of the absence of fire appliances within the sheds it was stated that all the ferry boats and tugs are supplied with fire pumps.

There are in all fifty-two transit sheds with a combined area of about eighty-two acres, while in addition the total warehouse area for storage purposes is 106 acres.

The transit sheds owned by the Harbour Authority are leased by the year or by the day. The Hamburg-American Line leases for twenty years seven sheds with an aggregate area of 115,000 square yards, and pays an annual rental of $325,000. This sum includes the railway equipment of tracks alongside the sheds and the installation and use of the cranes also. The Hamburg-American Company has leased a power station from the Harbour Authority and generates the power necessary for the lighting of the sheds and running of the cranes, which power is paid for in addition to their rent.

Handling devices within the harbour, under the control of the Harbour Authority, consist of tugs, dredges and fire boats.

Handling devices on the quay—cranes, the number and power of which are as follows:—

On 'Krahnhoft'—

1 large working steam crane, lifting 150 tons.
1 " " 50 "
1 " " 12½ "
1 " hand " 40 "

Inside buildings or fixed to outer walls of same:—

Warehouse 'A'—

4 hydraulic cranes, lifting 3,000 lbs.
4 hand cranes, lifting 2,000 lbs.
4 hydraulic lifts, lifting 2,000 lbs.

Warehouse 'B'—

8 friction winches, lifting 1,500 lbs.
2 hand cranes, lifting 2,000 lbs.
1 lift.

Collecting shed, Magdeburg Quay—

17 fixed hydraulic cranes, lifting 4,000 lbs.

Export shed, Hamburger Strasse—

6 fixed electric cranes, lifting 5,000 lbs.
1 hand crane, lifting 5,000 lbs.

Fruit shed "A"—

1 fixed electric crane, lifting 5,000 lbs.

Fruit shed "B"—

1 fixed hand crane, lifting 5,000 lbs.

Shed No. 16—

2 fixed hand cranes, lifting 5,000 lbs.

For transporting heavy goods from the quay to railway trucks or carts..... 42 hand cranes, lifting 5,000 lbs., some travelling, some fixed, outside of quay sheds on land side.

For loading or discharging ships on the dock side of quay sheds..... 442 travelling cranes, partly worked by electricity, partly by hand, partly by steam, viz.:—

263 worked by steam, lifting 3,000 to 5,000 lbs.
84 " electricity, lifting 5,000 to 6,000 lbs.
95 " hand, lifting 2,000 lbs., and
1 fixed steam crane, lifting 15,000 lbs.
1 " " 6,000 "
1 " " 2,000 "
3 " " 10,000 "

The use of cranes is included in the ship's dues charged against the ship.

Railways.—Direct railway connection with all the railways running from Hamburg is made with the transit sheds, the management of the harbour and quay railways being in the hands of the Prussian Railway Administration.

Lighting.—The lighting of the State piers and sheds is done by the Port Authority, and is partly gas and partly electricity.

Elevators.—There are no grain elevatiors owned and operated by the Port Authority. The Hamburg-American Steamship Company own and operate four pneumatic floating elevators with a capacity of 100 to 130 tons per hour, the type of which is a modification of the Duckham system in use at the Millwall Docks in London. These elevators are said to cost in the neighbourhood of $50,000 to $60,000.

Timber Space.—Special facilities for the storage of timber is provided by private authorities.

Special facilities for cold storage and live stock are provided by the Dock Authorities.

Four ice-breakers are used during winter months between Hamburg and the sea.

X.—Port Administration.

The controlling authority of the port of Hamburg is vested in the Central Government of the State of Hamburg, consisting of a Senate and a Lower House. The Lower House consists of 160 members, half of whom are elected by popular vote of all qualified citizens. A qualified citizen is one who is a native of or has been naturalized in the State, and who has paid an income tax for five years on an income of $300.00 per annum. Of the remaining 80 members of the Lower House half are elected by the judges, members of deputations, commissions, and courts of law, and the remainder by proprietors. The members of the Lower House are elected once every six years.

The Senate, on the other hand, consists of 18 members elected by all qualified voters for life. They are paid for their services, those who happen to be lawyers by profession getting $6,000 a year, merchants $4,500, and nine out of the 18 members of the Senate must be lawyers. The meetings and business of the Senate are transacted in private. Vacancies in the Senate are filled in the following manner:—

A Committee of Selection, numbering eight, four elected by the Lower House and four by the Senate. These eight members meet and select a list of four candidates for the vacancy, and from this list of four, after presentation to the Senate and Lower House, two are selected, one by each House. The initiative lies with the Senate, who presents laws after approval to the Lower House, and no law is sanctioned unless it receives the concurrence of the two Houses. In case of difference of opinion the two bodies select a commission to settle the matter.

The members of the Senate are the exclusive heads of the different Departments, known under the name of Deputations. That having authority over the port and its operation is called the "Deputation for Trade, Navigation, and Commerce," and consists of 16 members. The senior Senator presides over the Deputation. The Deputation presents reports to the Senate and the Senate, if necessary, to the Lower House. To facilitate executive efficiency the President of the Deputation is furnished with four expert officials. The Lower House votes all the money.

The Hamburg Port Authority appoints all the port officials, consisting of chief harbour-master, assistant harbour-masters, harbour pilots, and harbour inspectors. Allied with the Hamburg Harbour Authority, and in close executive relationship, is the Harbour Police Authority, who appoints the Captain of the Harbour police, Chief Commander, Commanders, and officers, and work in harmony with the officials of the port.

The executive staff consists of 1 superintendent harbour-master, 4 harbour-masters, each for a given district, 5 assistant harbour-masters, 2 harbour inspectors, 26 harbour pilots, 2 quarter-masters, 2 bridge masters, 2 crane masters, 2 bridge attendants, 2 assistants, and 15 sailors.

Pilotage is controlled by the same authority as the port. It is not compulsory, but vessels of 135 tons burthen and over must pay pilotage dues, whether they use the pilots or not.

The fire and police protection of the port are administered by the Port Authority.

XI.—Port Charges.

The following dues are levied against the ship:—

(*a*) Harbour-master's fee of $1.25 on each ship drawing not more than 6½ feet each time the ship enters the port, and $1.25 extra for every three additional feet. (There are certain special exemptions from the above charges, as in the case of yachts and pleasure boats or ships.)

(*b*) A tonnage due on sea-going vessels of 8 cents per registered ton. (This rate is again subject to certain variations in certain cases.)

(*c*) A charge for the use of the wharves of 12 cents per registered ton.

(*d*) A charge of 25 cents per ton levied against the goods loaded or unloaded on the wharves, $\frac{7}{10}$ths of which the ship pays, and $\frac{3}{10}$ths paid by the cargo; the whole, however, is paid by the shipowner, who collects the $\frac{3}{10}$ths from the merchant.

(*e*) The pilotage dues are as follows, and are charged according to the draft of vessels, viz.:—

Table of Pilot Dues.

—		Summer Tariff.	Winter Tariff.
Ft.	Ins.	$ cts.	$ cts.
2	3	6 10	8 55
6	9¼	8 55	11 05
9	10	11 05	15 90
13	1	17 15	24 50
16	4⅝	28 20	38 00
19	8¼	44 15	58 80
22	11⅝	60 00	80 85
26	3	70 00	96 50
29	6⅓	78 40	107 50

The following discounts are allowed:—

	Per Cent.
For vessels going only as far as Cuxhaven	25
If vessels take a pilot not before Cuxhaven	75
If vessels come in empty or in ballast	50
If vessels clear out to sea from Cuxhaven	50
After twelfth voyage in a calendar year of same vessel made with a Cuxhaven Government pilot	10
After twenty-fourth voyage under above-mentioned conditions	20
After thirty-sixth voyage under above-mentioned conditions	30
Extra fee if pilot takes the vessel to an Elbe port further than Gluckstadt	50

Note.—In case the river is full of drift ice the pilot is entitled to charge double the above stated dues.

The pilot due from Bosch Station to the Hamburg port is about 90 cents per foot draft of vessel.

The harbour pilot due is $2.40 per vessel.

There are no dues levied directly against the goods, and there is no intention on the part of the harbour authorities to change the method of raising revenue.

When the sheds are leased to different people temporarily the charge is 4¼ cents per cubit foot for the first five days, and ¾ cent per cubic foot per day for every day thereafter.

XII.—Financial Situation.

It can be therefore stated, although authoritative figures are not available, that the harbour of Hamburg, with its auxiliary Cuxhaven, has cost the State of Hamburg to date a little short of $100,000,000, and that the dues collected do not nearly pay the expenses of the port, and that the deficit is covered from other sources out of the general income of the State.

XIV.—General Impressions.

Port Extension.—Starting with the year 1888 with a well-defined scheme of port extension and development under an expenditure on river docks and harbour of $75,000,000, 2,500 acres of acquired property were consecrated to the provision of adequate water and pier areas equipped with transit sheds, cranes, and warehouses that have made Hamburg what she is to-day, the greatest Continental port, and puts her on the road to becoming the first port of the world.

Situated at the head of ocean navigation on the River Elbe, 76 miles from the North Sea lightship, Hamburg is met by a vast network of inland canals and small rivers which give her water access for distribution of her trade with a maximum depth of 6 feet, and a distribution area extending to Austro-Hungary, and covering Northern, Central, and Southern Germany. This stupendous expenditure on harbour and terminal development at the point where the farthest ocean inland navigation meets a system of inland waterways is unquestionably its justification. The fact that the River Elbe is tidal and of a sandy nature, with varying channel depths and compulsory continuous dredging, is the best assurance that if Montreal would adopt a similar courageous policy of development she, too, would command a trade future of which no power could rob her.

Notwithstanding this money already expended, the trade is pressing hard for further development, and a new dock basin of 34 acres extent, thoroughly equipped for ocean traffic, has been sanctioned and is under way at a further expenditure of $6,000,000.

THE PORT OF ANTWERP.

I.—Introduction.

The extraordinary development of the harbours and maritime commerce of Germany, Holland, and Belgium, in the last few years merits a study of the geographical, economic, or other conditions which have led to this wonderful improvement to the shipping and trade of Northern Europe.

The harbours of Germany, Hamburg, and Bremen, have not been developed to the least degree faster than the resulting increase in German shipbuilding and ocean trade.

The making of a great port of Rotterdam has been followed by an immense increase in Dutch tonnage.

The great seaport of Belgium is Antwerp. It has been claimed for it that it is the best port in Northern Europe; and as about half of its shipping flies the British flag, it has been called a British port.

Unfortunately for Belgium, the greater length of the entrance up the River Scheldt is through the Netherlands. This is probably one of the reasons why the shipping of Belgium has not advanced with its harbour, the advantage going to other flags.

It is, however, an invariable rule that the harbour development on modern lines, is immediately followed by new shipping and increased trade.

In Germany and Holland, therefore, any sacrifices made for the good of the ports result in increased trade and advances in shipbuilding and the maritime fleet.

In Belgium, the benefits are increased Belgian trade, and increased foreign trade through Belgium, both of immense benefit to the city of Antwerp and the country generally.

The population of Antwerp, including suburbs, is about 400,000, and it is in the centre of a very productive and prosperous district.

II.—Ocean Business.

The greater part of the ocean business to Antwerp is foreign.

The passenger emigration business through the port of Antwerp is very large, amounting annually to as many as 100,000, including those returning.

The following is the number of ocean vessels which entered the port of Antwerp in 1904:—

	Net tons.
Under 1,000	3,141
1,000 to 6,000	2,616
6,000 " 9,000	82
10,000 tons	13
	5,852

Of this number, 3,107 were British, 1,099 German, and 388 Belgian.

The total tonnage entered was 9,400,335.

The number of vessels, with their tonnage, from some of the principal countries during 1904 shows the widespread ocean business conducted through the port of Antwerp:—

Arrivals from—

Country.	No. of Vessels.	Tonnage.
Great Britain	2,248	1,816,593
Germany	705	1,862,879
India	168	543,598
Argentine Republic	181	464,617
United States	240	1,036,452
Canada	36	193,260

The number and tonnage, combining the arrivals and departures of ocean vessels for 1904 were as follows:—

Number of vessels	11,683
Tonnage	18,719,140

The chief imports are grain, animal products, coal, ore, and timber.

The exports are chiefly manufactured articles, metals, coal, and mineral matters.

III.—Features of Success.

Situation.—The harbour of Antwerp, situated at the head of ocean navigation, on the direct line of one of the trade routes of the Continent, and having splendid inland communications both by canal and by railways, is very similar to Montreal.

The River Scheldt is a small river compared with the St. Lawrence, and yet it is considered so good a maritime highway, that a harbour development at a cost of $100,000,000 has been made or authorized.

The more important features of success are that it is on the line of a great route, and the ocean navigation probably penetrates inland nearer to the centre of European business than at any other port. A radius of 100 miles takes in the whole of Belgium, the greater part of Holland, and a slice of both Germany and France.

Geographically, it is in nearly the same latitude as London, and only 30 miles further on the ocean route through Dover Strait. The length of river navigation is also approximately the same as compared with the port of London.

With natural and physical advantages, and an exceptional situation and good port facilities, Antwerp possesses one of the most successful and progressive ports of Europe.

The neutrality of the country also puts confidence in its stability as a port.

IV.—Types of Port Business.

The port business of Antwerp and of Montreal are very similar. The railway connections to the wharves are very good. The inland canal system and the ocean navigation meet in the harbour. Both cities are large markets for the interior, and goods are stored in warehouses as collected from interior points, or for distribution in return.

The three types of business in Antwerp are, therefore, as follows:—

(*b*) Ocean ship to railways.

(*e*) Ocean ship to canal barges.

(*c*) Ocean ship to warehouses by carts.

About half the freight of the port is by canal barges. A large proportion of this is loaded or unloaded direct. As, however, much of the goods has to be examined and sorted, the barges and the railways alike deposit or receive most of their traffic to or from the sheds.

This requires very large sheds and the best of handling equipment, as the barges have no derricks.

In this port the coasting traffic is very small, but the sea-going business with London, England, is very large, much of the foreign goods passing through that port.

V.—Port Types.

The port of Antwerp may be classed under two distinct types, as follows:—

(*a*) Riverside quays or jetties.

(*b*) Wet docks.

(*a*) The city front along the river is all lined with quays, which were originally the type of accommodation afforded for ocean vessels. The total length of wharfage along the city front is about $3\frac{1}{2}$ miles. The depth varies from one or two berths of 33 feet, up to just sufficient for the steamers.

The width of the river opposite the city is about 1,400 feet. The port of Antwerp does not take in the opposite shore, which is almost entirely undeveloped.

These riverside quays were built by the government, and then handed over to the Port Authority to equip and administer.

They were practically all built between 1880 and 1902. As an ocean port, therefore, Antwerp is of recent development.

(*b*) In the accommodation for ships, there are in the wet docks system eight important basins, with their auxiliary entrances and connections. Three other small basins of the same type are available for barges and small vessels.

There are also two large wet docks just about completed and ready for sheds and equipment. These basins are in use, although the large main entrance from the river is not completed.

The extent of wharfage in the wet docks is nearly 11 miles, of which about 9 miles is suitable for sea-going vessels.

All of the large new development authorized and under construction is of this wet dock type, the estimated cost being $55,000,000, not including the proposed new cut for the river.

VI.—Dry Docks.

There are six graving docks in connection with the port, all opening into one of the large basins.

The largest is 508½ feet long. Two other graving docks are situated on the opposite side of the river in connection with a shipbuilding yard.

There are no floating docks directly in the harbour, excepting one in connection with a shipbuilding yard a short distance up the river, at Hoboken, where there is also another dry dock.

VII.—Approach Channels.

Antwerp harbour is situated at the head of ocean navigation on the River Scheldt, a distance of 55 miles above the entrance from the North Sea.

In ascending the river the first 40 miles are through Holland, or the Netherlands. Two countries are therefore connected with the approach channel to Antwerp harbour.

Unfortunately the worst part of the river for navigation passes through Holland, the government of which country may not be expected to interest itself in improving, for the benefit of a rival port to Rotterdam.

It is reported that the two governments have recently come to an understanding with regard to very necessary improvements to the river, and to the aids to navigation.

There are two pilotage authorities. The Belgian pilots may conduct ships through Holland, and the Dutch pilots may take ships up to Antwerp, but not into the docks.

The drawback of the approach channel passing through a foreign country must be very serious in connection with a river, the channel of which requires a very great deal of improvement.

In comparison with other rivers, very little dredging has been done up to the present. If, however, the future of the harbour is to be preserved, not only very great improvements are required, but, on account of the unstable character of the river bed, continuous work will be necessary.

The bends or curves are something remarkable. From Antwerp down the river in a distance of about 6 miles, there are three curves of a radius of about ½ mile, each being nearly a mile long and having arcs of from 90 to nearly 120 degrees.

The standard curves in the River St. Lawrence Ship Channel are 1½ to 2 miles radius, and none of them make anything like a right angle.

The current of the Scheldt (or Escaut, as it is locally named) is about 3 miles per hour, about the same at the St. Lawrence at Quebec, and similarly changing with every tide.

The tides are slightly less than at Quebec, spring tides having a range of about 15 feet. There are no great variations in water level due to floods.

Along each bank there are dykes, the bed of the river having raised by silting up, with the resulting raising of the level of the water.

Fogs are very prevalent in winter, and considerable difficulty is sometimes occasioned to navigation by floating ice.

All navigation of trans-oceanic vessels is with the tide. Vessels frequently do not complete the distance in one tide. Anchorages are frequent and nothing is thought of delays for tide.

In case of a wreck resulting in a vessel filling, there is stated to be very little hope of saving the vessel, which settles rapidly in the sand.

While groundings are reported to be frequent, the damage is not usually serious.

There are over 50 tugs in connection with the river and harbour of from 20 to 650 horse-power.

The aids to navigation have neither the efficiency nor permanence of those in the St. Lawrence. The landmarks are far between, and the system of range lights is not developed to the same degree.

There are a large number of buoys, but none of the gas buoys can be compared with those adopted in the Canadian navigation.

Taking it altogether the Scheldt has neither the present navigable facilities nor the future possibilities of the St. Lawrence to Montreal. It is impossible to estimate the advantage of the permanence of the St. Lawrence channel and of its being under one authority.

The organization also, for the improvements, maintenance and control of navigation on the St. Lawrence are also considered infinitely superior to anything seen in any of the rivers approach channels in Europe.

There is always the possibility of delays and danger by ice in winter, as in 1894–95, but this danger is shared by its competitors.

VIII.—Accommodation for Vessels.

The total length of wharfage front in Antwerp harbour is as follows:—

Riverside quays	$3\frac{1}{2}$ miles..
Docks front	$10\frac{1}{2}$ "
	14 "

The riverside wharves alone can accommodate nearly 40 vessels. A large share of this, however, is reserved for channel and Baltic steamers and barges.

The docks accommodate an enormous number of vessels of all descriptions from small river open sail boats to splendid canal barges of 2,000 tons and large ocean ships; the estimated number of ocean ships in port at one time being 250.

The average tonnage of the ocean ships is about 2,000 tons, showing the large proportion of channel and Baltic vessels.

Judging by the number of vessels using the unfinished docks, and the few unoccupied berths, the port business is increasing equally with the accommodation.

IX.—Port Equipment.

Sheds.—The shed accommodation in the port of Antwerp is remarkable. The government having placed the riverside quays at the disposal of the Port Authorities, there is only one authority, and splendid facilities for the store and handling of freight have been furnished.

Single storey sheds are the rule. The wharves are of ample width, and therefore a single storey shed, 196 feet wide, has been adopted, instead of a narrow shed with two or more floors.

The shed area in the port amounts to the extensive total of about 75 acres. The construction is not of the permanent type of the new Montreal sheds. The floors are paved with rough stone blocks, and trucking is very difficult.

Promenades.—In the central part of the city a promenade has been constructed on the top of the sheds, overlooking the ships. This forms a very convenient and popular walk for the public.

Cranes.—Hydraulic cranes to the number of over 400 line the quays everywhere. These have a capacity of from 1½ to 2 tons. The newer cranes are designed to allow of four railway trucks running underneath, the front wheel of the crane running on the outside rail and the back wheel on a rail on the side of the shed. There are 9 or 10 powerful cranes of a capacity of from 10 to 120 tons.

Warehouses.—A large grain elevator of a capacity of 900,000 bushels, very much of the American type, is built by a company on land granted for a long term. There are six warehouses owned by the city, two of them being of four storeys and modern construction. They are not operated by the city, space being rented by the month at so much per square foot, the rental varying from 2 cents per square foot per month at the ground floor to one-fifth that rate for the upper floor.

Inland Canal System.—The Belgian canal system is immense. It is reported to have a combined length in Belgium alone of over 1,200 miles. The direct canals connecting the Rhine and other large waterways are large enough to admit of the navigation by large barges of 1,200 tons.

The interior barge traffic amounts annually to over 7,500,000 tons.

Railway Communications.—Besides being excellently situated as regards communication with the interior of Northern Europe by water, Antwerp has direct railway lines to the important centres of Germany, Holland, Italy and France. These, connecting with a splendid system of harbour railways, makes the exchange of merchandise between the *outre-mer* and the interior very advantageous.

X.—Port Administration.

The River.—The improvements and general care of navigation is under the care of the governments of Belgium and Holland, no charge or tonnage dues being made for the dredging required.

Pilotage.—The pilotage of ships is obligatory.

The rates are fixed by treaty between the two governments. It is considered that the Belgium pilotage system is equal to any in the world. Certificates of master are necessary, and there are several grades before reaching that of pilot of a large ship.

Aids to Navigation.—These are also maintained by the government.

The Port.—The governing authority of the port is the *Conseil Communal d'Anvers*, consisting of 39 elected members, and the burgomaster, appointed by the King.

A *College*, or committee comprised of the burgomaster and five aldermen, acts as an examining and advising commission.

An alderman, called *l'Echevin du Commerce*, has charge of the administration of the port and the marine police.

Another, having charge of works, construction, &c., is called *l'Echevin des Travaux public.*

A permanent consulting Commission, composed of five officials presided over by the Alderman of Commerce, meets once a month to consider and report on public matters.

The city owns all the principal basins and the port equipment.

The Government owns the quays on the river, and three small basins, which have been equipped by the city. It has confided the maintenance and administration of these sections of the port to the city under an agreement and a division of the proceeds.

In this way there is only one Authority in the workings of the port, not, however, including its channel approach.

XI.—Port Charges.

The port revenues are obtained as follows:—

From tonnage dues on ships.
Leases of land and other property.
Warehouses.
Dry docks.
Cranes, &c.

There are no port rates charged on goods, and, except when leased, no charge for use of sheds.

Goods remaining longer than five clear days are subject to a warehousing charge.

The charges against the ships vary according to the berth.

In the docks the rates are—10 cents per net registered ton.

At the riverside quays, or at anchor in the stream, the dues are:—

6 cents per net registered ton for each of the first ten voyages per annum, with a reduction for subsequent voyages.

Inland craft pay from 1 to 5 cents per ton for dock charges in the basins, but they are free in the river or at the riverside quays, or alongside ships outside.

The docks are not assessed for city taxes.

The charge for the use of cranes is $4 per day, including power and operator.

There are two pilotages, from the sea to Flushing and from Flushing to Antwerp. Each has an increased tariff in winter, but all are very moderate.

XII.—The Financial Situation.

The total capital expenditure on the construction and equipment of the port is approximately as follows:—

Riverside quays and equipment	$22,000,000
Docks and their equipment	23,000,000
Entire capital cost of port to date	$45,000,000

A scheme of new development on the line of an extensive system of Wet Docks has been sanctioned by the Government and entered upon by the city. The land has been secured, and the work commenced. The plan includes a canal having nine large docks opening upon it.

The scheme is estimated to cost about $55,000,000. A further scheme of diverting and straightening the river has been proposed, but not so far sanctioned.

XIII.—Port Design and Construction.

The former harbour was designed on the principle of Riverside Quays.

In all the later proposals for improvements and extensions the type is Wet Docks.

The reasons for preferring the docks is on account of ice in winter, the danger of collisions, and because further extensive development along the river front would take the wharves too far away from the city.

The silting power of the river current is also a question requiring consideration in a swift-running river and a sandy river bed.

The cost of the high walls in the river would be much higher, and their construction more difficult than walls in the dry, inland, before the basins are excavated.

The construction work is all done by contract.

The substantial provision for future enlargement, according to the approved plans, indicates confidence in the future navigability of the river, which presents many more difficulties than in the St. Lawrence to Montreal.

XIV.—General Impressions.

The success of Antwerp should give confidence in the future to Montreal as a port.

Considering situation, inland transportation, and the River St. Lawrence as the approach from the ocean, Montreal has incomparable advantages.

THE PORT OF MARSEILLE.

I.—Introduction.

In view of its situation in relation to the south of France, Italy, the Black Sea, Morocco, Egypt, and even India, the port of Marseille has very great natural commercial advantages.

The products from North America are required for consumption and manufacture, and for distribution to these places, by the large shipping companies of Marseille, of which there are fifteen.

Return cargoes of fruits, wine, macaroni, soap, tiles, &c., are sufficient to afford a regular trade.

The new Trade Treaty should show distinct results between Canada and the port of Marseille.

Twenty years ago Marseille was one of the up-to-date ports with reference to sheds, facilities, and equipment.

Though it cannot be now classed with the well-appointed ports of Europe, authority has recently been given for a large development, which has in view the future enlargement of trade with the interior of France by means of a canal connecting the harbour with the River Rhone.

The project was designed in 1870 by Engineer Guérard, who has since held the highest professional positions in France, and, with very little modification, was adopted by the Government in December, 1903.

From the present harbour a temporary sea wall is to be constructed to make a protected passage several miles in length to the edge of the Rove Mountain, through which it is to pass by a tunnel 4½ miles in length, and from there by a new canal nearly 20 miles long, to a junction with an existing canal which joins the Rhone 100 miles up, toward the interior.

The canal is designed for only small river vessels.

The proposed width is from 56 feet in the tunnel to 160 feet on the canal curves, and the depth 6½ feet.

The amount authorized for the construction is $14,200,000, of which one-half, $7,100,000, is to be paid by the State, $1,325,000 by the municipalities, $1,325,000 by the City of Marseille, and the balance, $4,450,000, to be provided by the Chambre de Commerce of the city.

The project was adopted after long discussion, especially in view of the decline of commerce, due to the great recent development of the ports of Germany, Belgium, and Holland.

It would appear, in view of the difficulties in communicating with the interior of France, either by canal or railway, that the future of any successful shipping development at Marseille must be on lines of city trade and transhipment business between Mediterranean vessels and oceanic shipping, for which Marseille is well situated, rather than from extensive export and import business of France.

II.—Ocean Business.

The port of Marseille is the home port of a very large Mediterranean fleet of vessels, mostly owned and operated by French companies; the business is largely the bringing of products from all points in Italy, Turkey, Russia, Austria, Egypt, and Morocco, for ocean distribution, and the re-shipment of trans-oceanic business to these same ports.

The trade is quite extensive. Transhipment takes place from ocean vessels to all sorts of craft, from the Italian felucca to the splendid Alexandria steamers, and to the numerous vessels of the Black Sea fleet.

There are at Marseille a considerable number of establishments for the manufacture of soap, macaroni, wine, tiles, cement, &c., which add to, and are developed in connection with the commerce of the port.

The vessels to be seen in the harbour are of every type except as limited by the draught of water and the harbour accommodation. The P. & O. Indian steamers do not all now call here, and the larger German ships go to Genoa.

The trade results of the port to the country, appear to be confined to an immense passenger business through France, *en route* to Mediterranean and Indian points. The freight business, by rail, with the interior, is limited by very inadequate railway accommodation as furnished by the one railway company.

The commerce is mainly responsible for what prosperity there is in the city of Marseille, and the ownership of the shipping is largely held throughout France.

III.—Features of Success.

The history of the port of Marseille is full of romantic incidents connected with the various epochs of southern European power and decline.

The remains of the Greek harbour still exists in much the same outlines as developed for the commercial and strategic requirements of the age of supremacy of Greece.

The present "Vieux Port" was built by the Romans, and for commerce and vessels of the types in vogue at the time of the Roman domination, it can still be pronounced marvellous.

The commencement of the modern development of the port of Marseille dates from 1853.

Owing to the fact that the bay is completely surrounded by rocky, mountainous, sloping shores, it was necessary to encroach on the sea for further harbour area.

The fierce frequent high winds, called the "mistral," made it necessary to take special precautions to render the new development a place of absolute shelter and safety.

Accordingly a massive sea wall was constructed parallel to the shore, at a distance of about a quarter of a mile. The first enclosure, Bassin de la Joliette, was made rectangular in form, 1,200 feet wide and 1,600 feet long, parallel to the shore. Cross walls with narrow entrances 75 and 200 feet in width connect with the shore quays, and a narrow canal in complete shelter, inside the entrance, connects with the Old Harbour.

In this basin all vessels either anchor or moor end-on to the quay. Every thing is lightered, or carried ashore on narrow gangways hanging from the stern of the vessels, which are tied up in rows about 10 feet from the quay walls.

Successive rectangular basins have since been constructed all of the same general type, except in one case, where the direction of the shore makes a triangular basin necessary.

The later docks have been made larger, the largest being 1,600 feet wide and 2,800 feet long. Three moles, or piers, make accommodation for ships which desire to berth alongside the quays.

The inside of the breakwater is finished as a longitudinal wharf, for waiting vessels, coal, or other bulk freight.

In the new harbour development there are now six basins, de la Joliette, du Lazaret, d'Arenc, de la Gare Maritime, National and Bassin de la Pinede.

They are each almost completely separated by means of cross walls, having narrow passes for vessels, which are crossed by swing bridges.

As the sea front was, before the construction of the breakwater, quite useless, being an exposed rocky shore, and everything being built out beyond the original beach, private ownership of land or water front did not here add to the difficulties, as frequently experienced in places long inhabited and improved. Even the quays along the shore were built on made land, giving ample width for wide streets and railways.

The situation of the harbour of Marseille is in a bay or gulf, surrounded on three sides by high sloping rocky banks, and completely exposed on the fourth side to the full force of the Mediterranean. There are also the fierce mistral winds down or up the valley of the Rhone, caused by the great changes in temperature between the African shores and the Alps; which at certain seasons of the year are almost constant.

Geographically, Marseille is splendidly situated as a connecting point or interchanging point between oceanic shipping and Mediterranean, Black Sea, and Indian vessels.

If good railway or canal communication could be obtained, the situation for southern French commerce would also be unsurpassed.

The various authorities all admit that the railway accommodation, except for passengers, is quite inadequate, and present communication with the Rhone waterway is almost impossible on account of the exposed 20 miles of coast line to be navigated, until the canal and tunnel now under construction is completed.

The extent of the shipping of the Mediterranean which could conveniently centre for distribution to the world at the port of Marseille is very great.

The south of France trade, with good transportation routes into the interior, would also be sufficient for the commerce of an important shipping centre.

The question of the establishment of a free port zone, as an inducement to make Marseille a point for the manufacturing and assembling of local and foreign products and the making of a great warehousing market, is a live one at present, in the hope of reviving the activity somewhat lost since the wonderful development by the Germans of Genoa.

IV.—Types of Port Business.

(a) *Ocean Ship to Coasting Ship.*

This is, owing to location and transportation facilities into the interior, the principal port business of Marseille.

Much of the work of interchange is carried on by means of lighters, as is also a considerable share between the quays and the ships.

(b) *Ocean Ship to Railways.*

Owing to the position of the port, surrounded by heights, cheap railway freight transportation is exceedingly difficult. There also appears to be no competition, all railway business being carried on by one company, which caters almost exclusively to passenger and express freight business.

(c) *Ocean Ship to Warehouse by Carts.*

A considerable part of the business is carried on by great two-wheeled carts drawn by as many as five horses, tandem, between the quays and the warehouses and manufacturing establishments in the city. All sheds are open to carts.

As there are at present no inland canal connections, or city canals, there is no barge business.

V.—Port Types.

The port of Marseille may be classified under the subdivision—

Tidal Basins.

There is a very slight tide, but the openings into the basins without gates, give free access to the sea.

The water of the Mediterranean is clear and free from sediment, so that the difficulties of keeping the depth once attained are not serious.

The quay walls, or wharves, are all low level, not more than 5 to 8 feet above the water.

The entrances to the system of docks, of which there are two, one at each end, are easy of passage if there is not too much wind, but frequently vessels, have to anchor under shelter of the hills and wait for the wind to fall, and the records of groundings are somewhat numerous.

All the basins are closed on the side next the sea, by the sea wall or breakwater. This is constructed of massive masonry, and further protected by immense blocks of concrete deposited irregularly. The length of this sea wall is about $2\frac{1}{4}$ miles. A magnificent promenade about 30 feet above the water extends the whole length, for foot passengers only, and is a popular resort for obtaining the beautiful sea air, a splendid view of the whole harbour being obtained.

VI.—Dry Docks.

There are six dry docks in the harbour of Marseille. These were constructed by the "Cie des Docks et Entrepôts," after having been given the sites, and a large proportion of aid by the State, as well as the usual concession.

A large yard, 2,400 feet long and 600 feet wide, is enclosed, containing a large basin into which the dry docks all open, and the shops, &c., for repairing vessels.

The system is an admirable one for vessels of medium size and draft. The largest dock is not quite 600 feet long and has an entrance depth of $22\frac{1}{2}$ feet.

In connection with the new basin authorized, a modern dock of ample size is proposed.

There are no floating docks in this port.

VII.—Approach Channels.

From the Mediterranean Sea into the harbour of Marseille there are two entrances, the "Avant Port Sud" and the "Avant Port Nord." These avant-ports are practically sheltered by the breakwater, so that the passes into the

basins can, except under extraordinary conditions of weather, be safely made by the aid of tugs.

From the open sea into the avant-ports the entrances are respectively 1,400 and 1,900 feet wide, and the passes into the basin 236 and 350 feet wide.

The entrances from the sea are naturally deep and the courses of vessels absolutely unobstructed.

VIII.—Accommodation for Vessels.

The available depth for vessels varies. In the centres of the basins there is 20 feet depth in the Old Harbour, and as much as 60 feet in the Bassin de la Pinède, recently completed. At the quays or wharves, however, the depth available is greatly less, being from 10 feet in the Old Harbour to 26½, or a maiximum of 27½ feet, in the newest basin.

The total length of wharfage accommodation is about 10 miles, of which about 8 miles is suitable for the use of steamers. This, however, does not represent the available berths for vessels.

In the basins, a large number of vessels anchor to discharge and take cargo by lighters. As, however, there are no inland canals, the large number of lighters at the quays take up as much room as the ships would themselves. Vessels of greater than 28 feet draught require to anchor, on account of the depth alongside the wharves.

The total length of the breakwater is slightly more than 2½ miles.

The widths of the piers vary from 280 to 400 feet, and the length from 400 to 1,200 feet.

The widths of the basins, between piers, vary from 400 to 700 feet.

Good wharf accommodation exists for vessels of from 25 to 28 feet draught to the number of from 25 to 35. Smaller vessels to about equal number may use the inside of the breakwater.

Others may double up, moor end-on, or anchor, all in safe shelter.

Shed accommodation exists for about 24 vessels.

Dolphins and mooring buoys are placed at convenient places for mooring ships while discharging or loading, without going to wharves.

The harbour occupies a water front of about three miles in length, all in close proximity to the city.

IX.—Port Equipment.

Sheds and Warehouses.—Twenty years ago the sheds and equipment of the port of Marseille were remarkable as being in advance, in many features, of similar development elsewhere.

A concession having been granted to the Dock and Warehouse Company for a long term of years, that company had erected splendid sheds and storehouses, and equipped them with cranes and hoists of the latest inventions.

The later harbour developments having been carried out by the Port Authority, the Chambre de Commerce, sheds to the number of 12 have been erected, almost all single-storey. They are from 85 to 121 feet wide, the floors being on wharf level. One line of railway tracks extend between the shed and the ship, and two tracks behind the shed. On the edge of the quay an independent line of rails carry the cranes.

The floors of the sheds are paved with stone blocks, and heavy carts are admitted on defined longitudional roads and transverse lanes.

It having been found that single-storey sheds, even of a width of 121 feet, was insufficient for taking the whole cargo of the larger modern vessels, the later developments are of the type of the Liverpool double-storey sheds.

The columns are spaced 33 feet apart longitudinally and 23 feet apart across the sheds, the height of the ground storey being about 20 feet.

The second storey floor is calculated for a weight of 410 pounds per square foot.

The foundations are on concrete piles.

The upper floor is designed principally for inward cargo, discharged from the ship. It is lowered to wagons by chutes, or to cars by jiggers.

Freight, from the land side, to be placed in the upper storey, is taken up either by the cranes on the quay front or special cranes situated on the roof on the road-side.

The maximum capacity of this double-storey shed is calculated at 45 tons per running foot, which would be 22,500 tons for a 500-foot shed.

Freight Handling Devices.—The equipment of the port is also owned and operated in three different ways:—

The Docks and Entrepôt Company has—

Hydraulic cranes, fixed.
" on rails.
Electric cranes on rails.
A floating crane, 20 tons.
A floating elevator.

The Chambre de Commerce has—

60 or more hydraulic cranes, on rails, of a capacity of from 1 to 3 tons, and many hand cranes.
1 large fixed crane for extra heavy weights.
30 electric cranes on rails (being installed).

In 1903 the cranes in operation were used on an average of 121 days out of the 300, or 40 per cent of the working time.

The various stevedores and contractors and private companies also own several floating elevators and a number of floating cranes of a capacity of 2 to 45 tons.

The new electric cranes now being installed are of the Liverpool type, one rail on the quay and the other on the shed.

Harbour Railway.—Almost all the wharves have railway communication direct to the sheds and ships. These connect with the railway company's terminal yards and stations, which are conveniently located.

Transverse carriages for moving cars from one track to another are located on the ends of all piers.

These harbour railways appear to be owned by three different corporations:—

A company having an old concession.
The Docks and Warehouse Company.
The Chambre de Commerce.

The Docks Company operate their own traffic on the wharves, the remainder is exploited by the P.L.M. Railway Company.

Tugs and Lighters.—Tugs to the number of over 60 are owned by private companies, some of them being of great power.

There are a great many small lighters and flat scows, for the transportation from the quays to the ships, which system does not recommend itself, except for ships of such great draught that they cannot approach the wharves.

Fire Protection.—In connection with the port there are maintained two powerful fire and wrecking vessels.

Police.—The police service is considered as for public security, and is attributed to the city. Being considered insufficient, the Chambre de Commerce

tried a special police service in 1901. This did not give the expected results and it was given up. It has been proposed to institute a special service for the outlying docks, of a steamer with a company of officers and men to live aboard, for regular police duties, at the expense of the Chambre de Commerce.

X.—Port Administration.

The authorities engaged in the development of the port of Marseille appear to be as follows:—

(*a*) The Cie des Docks et Entrepôts.—This company has a concession covering a large portion of the harbour, and the complete dry dock and shipbuilding establishments. Up to and including 1904, their share in the port expenditure amounted to about 25 per cent of the total.

(*b*) The Government.—The expenditure directly made by the Government amounted to about 65 per cent.

(*c*) The Chambre de Commerce of Marseille.—The balance, about 10 per cent of the total, mostly for equipment and sheds, was expended by the Chambre de Commerce.

The city of Marseille appears to have taken very little share in the port development.

The concession of the Dock Company, which dates from 1856, and which marks the beginning of Marseille as a large seaport, gives to that company practically complete authority and administration privileges over two out of the six large basins.

This company has also a concession covering the dry docks and yards, constructed partially at the expense of the company and partially by the State.

The Chambre de Commerce, since as early as 1859, is reported to have always taken a very considerable interest in the development of the harbour. The Government of France has, however, made the greater part of the contribution towards the development of the port.

The construction of the breakwater and of most of the piers, bridges, and permanent works were made directly by the Government

The equipment and charge are delegated to the Chambre de Commerce acting under the "Administration Supérieure," represented by the Ministre des Travaux Publics.

XI.—Port Charges.

Sheds.—At unreserved sheds, the dues on merchandise are at the rate of 10 cents per ton for periods of from 8 to 12 days, according to the amount of the cargo.

The time counts from the day the vessel completes discharging or from the day freight commences to be delivered.

After the expiration of the regulation period, a charge is made for the first three days of 10 cents per ton per day, and after that 20 cents per day.

In cases where goods are unloaded and removed within 24 hours, the charge is only 3 cents per ton.

Authority may be given for the renting of sheds for six month periods, at the rate of about 9 cents per square foot per semestre.

The total amount of freight reported as passing through the sheds in 1904 amounted to nearly 900,000 tons, or 1½ tons per square foot of the floor area.

Cranes.—For cranes of 1¼ tons, including power and operator, $6 per day of 10 hours is charged. For cranes of 3 tons, $8 per day of 10 hours.

The total receipts from cranes alone, during the year 1904, amounted to nearly £40,000.

Railways.—Charges made by P.L.M. Railway for transportation between quays and terminals, including the dues to the Chambre de Commerce:—

	Cents per Ton.
1. General merchandise	26
2. Grain, sugar, wines, &c	23
3. Bulk freight	20

Freight billed to ships is not charged this tariff.

All passengers arriving or departing by the special steamer trains are charged by the Chambre de Commerce a head tax of 5 cents.

In 1903 the Chambre de Commerce, after paying interest and all other charges, had a reserve from the charges for the equipment of sheds, railway tracks, cranes, &c., of $37,262.40, which was added to the sums to be used for further ameliorations.

The railway company, out of its charges of from 20 to 26 cents per ton, pays a profit of about 5 cents per ton to the Chambre de Commerce. In 1904 this amounted to about $20,800.

This rate of 5 cents per ton, *of profit*, would be at the rate of $1 per car carrying 20 tons, and is included in the *railway company's charge* of $4 to $5 per car, of that capacity.

Besides the charges for equipment, the following are the port charges, for steam vessels, other than from Mediterranean or European ports, per registered ton:—

		$ c.
Tonnage dues		0 20
Pilotage	Inwards 0 04.4	0 07.4
	Outwards 0 03	
Health Office dues		0 03
Sundry, surveying, weighing, Tribunal of Commerce, lifeboat, &c		0 05
Brokerage, for over 1,000 tons, per ton of cargo, loaded or unloaded		0 05

XII.—The Financial Situation.

Expenditure.—From 1815 to the end of 1904, according to the admirable report of M. A. Batard-Razelière, Chief Engineer of the port of Marseille, the figures of expenditure were as follows:—

	$ c.
By the State	18,970,929 00
Chambre de Commerce	3,151,908 00
Cie. des Docks et Entrepôts	7,317,088 00
City of Marseille	34,815 00
Total	29,474,740 00

Tonnage Returns.—From the same report, the tonnage for the five years to 1903 amounted as follows:—

Inward and Outward combined.

—	1899.	1900.	1901.	1902.	1903.
Number of vessels of all classes	17,764	17,254	16,802	17,008	17,608
Tonnage	12,567,602	12,376,166	13,087,098	12,263,274	14,465,584
Weight of freight, tons	6,316,494	6,221,373	6,350,954	6,488,067	7,059,414
Average tonnage of vessels	700	710	780	720	820

The figures of tonnage are, however, somewhat misleading. When the same vessel enters and clears, the tonnage is recorded each way, and therefore double the returns, as by the Canadian manner of reckoning.

The weight of freight, however, and which is a very useful record, is the actual amount exchanged in the port, inward and outward combined.

XIII.—Port Design and Construction.

Design.—The harbour is purely artificial, being built out into the sea, and protected by a massive breakwater.

Every effort has been made to concentrate the docks near the centre of the city. The protection works and many of the docks had therefore to be constructed in deep water.

The cost of the harbour, with its 8 to 10 miles of wharf front, has, therefore, amounted to the relatively high figure of over $30,000,000.

The design is symmetrical. A magnificent promenade extends from one end of the breakwater to the other, overlooking the Mediterranean on the one side and the harbour on the other.

Construction.—From the protection works to the piers, dry docks, sheds, and cranes, everything is substantial and, as far as possible, permanent.

Splendid masonry, magnificent concrete work, and all fenced in by an artistic iron fence, gives a good idea of the character of this, the chief commercial national port of France.

The depth of water on the quays, however, is a matter of surprise, in view of the draught of modern vessels, the walls of latest pier having only been founded at a depth of about 29½ feet, with a depth of water of less than 28 feet.

Provision for the future.—This has been amply provided for, on the same symmetrical plan, the new basin, already authorized, to be 2,000 feet square, and designed to be an extension of, and to open into, the present system.

The estimated cost of the new basin, without equipment, is $5,000,000.

The breakwater and piers are constructed departmentally by the Government, and the sheds and equipment for the Chambre de Commerce, by contract.

Foundations for the quay walls are brought up to the required level by rip-rap. On this the walls are built up, being tiers of massive concrete blocks, backed by a heavy sloping wall of rip-rap, the interior between the walls being filled up with excavations.

The water level not fluctuating to any extent, high quay walls are not required, and the concrete block walls are perfectly stable, and very much cheaper than those required where there is a tide or considerable inequalities in water level.

XIV.—General Impressions.

Recognition as a National Port.—Although the trade is not largely of a national character, the large proportion being directly for the city or for transhipment into foreigh vessels, the port has been developed by the Government to the extent of $20,000,000.

Inland Water Communications.—A canal is now being made at great cost to obtain inland water communication with the interior. This canal will cost probably $20,000,000 and then only give a depth of about 6½ feet, which indicates the value placed on inland water communication.

Differences of Opinion.—Lack of harmony between the different port interests was in evidence, and general dissatisfaction appeared to exist as to the progress of the port.

Authorities.—The disadvantages were apparent of having three authorities and at least two adminstrative systems in the port, viz.:—

The Government;
The Chambre de Commerce;
The Cie. des Docks et Entrepôts.

The visible results of some features of policy with regard to harbour development and administration, may be seen by the transfer of business which formerly was done at Marseille, to Genoa, showing, that even with government support and a splendid natural situation, a port may be distanced by foreign competitors.

PORT OF HAVRE.

I.—Introduction.

Of all the French ports, Havre enjoys, from her prominent position on the English Channel, the right to look to the future with confidence. Just as soon as her port Authorities carry out the plans they have in view, her business must expand phenomenally.

II.—Ocean Business.

Havre is the home port of the great ocean line of which France is so justly proud, La Cie. Transatlantique, which is rapidly developing into one of the strongest shipping companies in the transatlantic business.

It is the only French port on the English Channel to which Atlantic liners can reach the docks, and therefore is really the passenger port of France.

A large cotton trade is, however, developing, and every effort is being made to encourage the importation of raw rubber, and these efforts are meeting with gratifying success.

All types of steam, sailing craft are seen in the busy harbour, and her trade returns are growing year by year. Her tonnage is 8,837,978.

III.—Features of Success.

The River Seine, leaving Paris, winds its way through the fertile valleys of Normandy, passing the historic town of Rouen on its way to the sea, and empties into a large bay made by the projecting promontories of Capes Antifer and Barfleur, which are 55 miles apart. Past this great gateway flow the tides of the English Channel. The various currents in this curious area of the sea, seem to counteract the tide, so that the waters reaching Havre, France's great harbour at the mouth of the Seine, remain at high tide for three hours, whereas in ordinary cases the tide recedes as soon as it is high.

The natural depth of the bay and the character of the bottom lend themselves well toward any intended development. Geographically, no Continental port excels Havre in point of position. On the open sea, in the direct path of the great liners and the transatlantic steamers, the natural distributing point for central European trade, it is a matter of considerable wonder why Havre has not attracted a larger share of Continental business.

IV.—Types of Port Business.

(*a*) Ocean ship to coasting ship.
(*b*) Ocean ship to railways direct.
(*c*) Ocean ship to warehouses by vehicle.
All are in operation.

V.—Port Types.

The jetties of the outer port are all approachable from the sea. Her development consists principally of tidal basins and docks, of which there are ten.

VI.—Dry Docks.

The port of Havre has six dry docks, the largest of which will take a vessel 541 feet in length. The fact of Havre not possessing a larger dry dock has been the cause of sending the large boats away from the harbour to be refitted.

VII.—Approach Channels.

The sea approaches to the port are marked by some of the finest lights in existence; the one on the Cap de la Heve has 2,500,000 candle power, and can be seen in clear weather for a distance of 52 miles.

The sea channel at the entrance has an outside width of 656 feet, with a high-tide depth permitting boats drawing 24 to 26 feet. There is another approach channel from the south-west 1,482 feet long by a minimum width of 328 feet.

VIII.—Accommodation for Vessels.

The port itself consists of an outer and inner harbour, protected from the sea by long masonry arms.

The quay length of the outer port is about 1,600 yards. The water area comprises about 50 acres, and the quayage accommodation for the storage of merchandise about 5 acres.

The works now under construction will increase the water area and make a practically new outer harbour comprising an area of 175 acres, the entrance to which will be 656 feet wide, approachable by a channel having a width of 984 feet and a minimum depth of 29 ft. 6 in.

An ocean wharf 1,640 feet long, is under construction in the southern part of the new outer port, which will be accessible at all hours to boats drawing 29 ft. 6 in. of water. This will be particularly adapted to passenger traffic, and will be furnished with direct railway communication to all parts of the Continent.

An entrance lock to the inner harbour leading to the Eure Basin provides facilities for the largest vessels to enter during high tide, and for vessels drawing not more than 19 ft. 6 in. at low tide. This entrance will be 100 feet wide and have a length of nearly 800 feet. The port proper consists of 10 wet docks or basins as follows:—

King's basin, Barre basin, Eure basin, Citadel basin, Commercial basin, Vauban basin, Dock basin, Bellot basin, Canal basin, and a petrol basin.

The combined water area of these basins will be nearly 200 acres, possessing a quay length of 40,500 linear feet and a quay area of about 120 acres, after deducting the streets and the space occupied by railway track approaches.

In addition to these 10 wet basins is a tidal basin 1,100 feet in length, which will ultimately connect with the Bellot basin by an enclosed lock admitting the passage of vessels having a length of 600 feet.

These different basins are connected by 15 entrance locks, varying in width from 39 to 100 feet, and in depth from 22 to 35 feet.

IX.—Port Equipment.

The equipment of Havre by the Chambre de Commerce consists in the following, the use of which is charged for under tariffs of rates published from time to time;—

28	movable hydraulic cranes	1,500 to 2,500 lbs.
2	" " "	3,000 " 6,000 "
2	" " carriers	400 lbs.
2	" " "	2,000 "
14	" electric cranes.....	3,000 "
1	set of shear legs.....	120 tons.
11	movable electric cranes	3,000 lbs.
5	" steam cranes.....	3,000 "
6	floating steam cranes.....	2,500 "
1	" " "	8,000 " } fire pumps.
1	" " "	20,000 " }

Power and attendance are furnished by the Chambre de Commerce.

The different quays are furnished with transit sheds of various sizes and depths, of which 26 have been erected by the Chambre de Commerce, having a total length of 9,000 feet, covering a space of 95,000 square yards. They vary in width from 20 to 200 feet, and in length from 125 to 700 feet.

Besides these there are others privately owned by—

The Dock Warehousing Company.
La Cie. Transatlantique.
Hamburg-American Line.

The best passenger sheds of any port visited are at Havre, and belong to La Cie. Transatlantique. Broad, spacious two-storey accommodation, the ground floor used for luggage freight and railway facilities. On the first floor are the waiting-rooms and passenger department, fitted up with every comfort.

X.—Port Administration.

The controlling authority of the port is vested in the Chambre de Commerce, whose action is subject to revision by the State, through the Minister of Public Works.

Other authorities in the port with vested interests acquired from time to time are:—

The Dock Warehousing Company leases and operates 300,000 square yards, of which 170,000 are covered with warehouse accommodation with a capacity of 270,000 tons.

The General Warehousing Company have 152,000 square yards of covered shed space, with a storage capacity of 100,000 tons.

The Pont Rouge Dock Company controls 93,000 square yards, with a storage capacity of 92,000 tons.

The General Storage Company of Paris occupy 13,000 square yards, storing 31,000 tons.

The Tancarville Canal Company, 35,000 square yards, with storage facilities for 40,000 tons.

The Chambre de Commerce has, since 1818, taken a prominent part in the development of the port, under whose auspices in that year was formed "The Havre Port Company" with a capital of $600,000, the merchants contributing two thirds and the State one third, the State taking over the revenue of the port for the years 1818, 1819, and 1820 to recoup itself for the advance made to the company.

This partnership between the State, with its headquarters at Paris, and the Chambre de Commerce at Havre has not been without very severe drawbacks from which the port has been long suffering. The history of the negotiations between the two Authorities for the carrying out of work which is now nearing completion began in 1879. In consequence of these long-drawn-out proceedings and political intervention great delay has been wrought in the development of the port, a large tonnage has gone elsewhere to other ports which have not been the victims of political interference or become dependent upon administrative authority exercised from afar.

For 30 years the Chambre de Commerce has struggled to overcome this state of affairs, but the money voted for port improvement has been received in such small amounts at a time that the port, which is in a grand position, opening right out into the English Channel, and only $2\frac{3}{4}$ hours from Paris, is not by any means doing the share of Continental trade she ought, although every effort is now being made to regain lost ground.

XI.—Port Charges.

The rental tariff under which the different sheds are leased is as follows:—
Per net registered ton per day—

	cts.
1. Ships occupying a berth furnished with a shed exceeding 148 feet in length pay	$1\frac{4}{5}$
2. Ships occupying a berth furnished with a shed 98 feet up to 148 feet wide pay	$1\frac{3}{5}$
3. Ships occupying a berth furnished with a shed under 98 feet pay	$1\frac{2}{5}$

Sailing vessels are charged under a different rating.

There are certain modifications and rebates allowable under this tariff, provided the vessel exceeds in length the shed, and provided certain other conditions as to cargo are complied with.

The Chambre de Commerce lights the sheds free of charge, but undertakes no responsibility with reference to cargo.

These rentals are paid for the use of the shed by the lessee, who has the right of recovering a portion of it by putting a charge on the merchandise handled of—

4 cents a ton on cotton and woollens.
5 " " " all other merchandise.

Cargo is allowed to remain on the quays 72 hours.

A penalty of one cent per ton per day is charged for the first five days succeeding the 72 hours, 2 cents per ton per day for the next five days, and 4 cents per ton per day for each additional day after.

Cargo arriving for export and deposited in the sheds before the arrival of ship on which it is to be loaded pays 60 cents per day for every 50 square yards occupied

Tonnage Dues on Ships.

Tonnage dues applied on the legal tonnage of each vessel entering the port to load, unload, or transfer cargo:—
Per net registered ton per voyage—

	cts.
1. Ships trading between Havre and non-European ports (with exception No. 3)	8
2. Ships trading between Havre and European or Asiatic ports (with exception No. 3)	6
3. Ships trading with any port whose cargo consists of at least nine-tenths cereals, balsam oil, iron ore, &c	4

Regular lines having at least one sailing a week are entitled to a reduction of 40 per cent under Nos. 1 and 2.

Regular liners having a monthly sailing are entitled to 30 per cent reduction under Nos. 1 and 2.

Vessels remaining longer than two months in the port are charged an additional tonnage rate of 2 cents per week per ton.

Railway access to the principal quays is provided.

The Western Railway Company handles the rail traffic to and from the docks to its own freight yards and charges therefor 6 to 12 cents per ton, according to the nature of the goods handled.

The port suffers from a single railway approaching the port owned by a private company. As its purchase for a long time has been contemplated by the Government, nothing has yet been done to improve the railway facilities to and from the port, in consequence of which these are far from being satisfactory. This, however, will soon be remedied.

THE PORT OF MONTREAL.

Introduction.

The first attempt to make a harbour for ocean vessels at Montreal was in 1830.

The Canadian inland canal system, connecting the Great Lakes of the central part of the North American Continent with the St. Lawrence at Montreal, had just been opened. The physical features of the locality, the trade situation, and the position as a point of interchange between ocean and inland vessels, was recognized.

Westward was the canal system to avoid the Lachine and other rapids.

The City of Montreal was fast becoming a commercial and manufacturing centre, and the situation for warehouses and works was excellent.

Eastward was the mighty St. Lawrence, with its clean water and permanent river bed, passing through Lake St. Peter and on 160 miles to Quebec, and 800 miles further to the Atlantic.

Navigation to Quebec was an accomplished fact for all classes of ocean vessels, but Lake St. Peter, half way up to Montreal, had only a depth of 10 feet.

The Ship Channel.

Commencing modestly as it would be considered at the present time, but on right lines, the Montreal far-seeing business men undertook to construct a harbour, and to deepen the channel in Lake St. Peter.

Their lessons were gained from the successes in taking ocean navigation up the Clyde, which had been a shallow stream, to Glasgow.

Dredging on the St. Lawrence commenced in 1850. The plant had been designed and the machinery made in Scotland.

From 10 feet in 1850, the channel had been deepened in 1888 to 27½ feet at ordinary low water, over a length of river requiring dredging of about 50 miles, the work being carried on departmentally by the Harbour Commissioners of Montreal.

In 1888 the Government of Canada, recognizing the St. Lawrence as the national route of Canada, assumed the debt incurred with respect to the channel, and opened the waterway free to the shipping of the world.

The Government in 1899 undertook as well the task of deepening the channel about 4 feet, to obtain a depth of 30 feet at the lowest stage of river level recorded, and of widening, straightening, and marking the channel with the most modern systems of Aids to Navigation.

In 1907 the channel was opened to commerce, with a depth of 30 feet, the actual lowest recorded depth that season being 31 feet 10 inches, and with a magnificent system of lights, buoys, signal service, and swept channel.

The standard curves are easy and the width ample, as compared with any other artificial navigable waterway of the world.

The sketches (*see* pages 161, 162) show to the same scale a comparison between the cross sections and curves of the River St. Lawrence Ship Channel, as compared with those of the noted maritime highways of the world.

Montreal Harbour and the St. Lawrence has had a bad name. It is unfortunate that in Canada misfortunes are advertised. The facts and actual records show to the contrary, and the St. Lawrence should be known as one of the most advantageous routes in the world.

The St. Lawrence, with the whole of the Great Lakes navigation, amounting to 60,000,000 tons per annum, is closed by ice from December 1st to April 20th of each year. This situation is accepted on the Great Lakes, which are the feeders to the shipping of the St. Lawrence. When the Lakes are open the ocean ships are in the Montreal Harbour, ready for the trade.

During the open season, the St. Lawrence has splendid weather conditions, and is notably adapted to navigation.

Fogs are very rare in the whole of the contracted part of the river from Murray Bay, 235 miles below Montreal, right up to the Harbour.

In 30 years only two ships have been totally lost between Quebec and Montreal.

Groundings, which are so well advertised, are not frequent. The reports of 1906 state that between Montreal and Quebec the loss due to navigation accidents did not amount to one thousand dollars, although about 3,000 ocean vessels, of a combined tonnage of about 6,000,000 tons passed up and down during the seven months of open season.

The records of the accidents on the St. Lawrence give the causes about equally divided between faults due to the machinery of the ship, and errors of the pilots.

None of the accidents whatever in recent years have been due in any measure to the channel.

The Harbour.

In the consideration of Montreal as a position for a great port, except for its winter season, it would be regarded as an ideal situation, according to the best British and Continental practice.

1. It is as far inland as it is possible for ocean navigation to go.
2. It has a splendid channel approach and a dredging plant and organization for navigation at least equal to any in the world.
3. The navigable conditions are excellent.
4. It is on the direct line of the great Summer trade route of North America.
5. It is the most advantageous ocean port for a large section of the North American Continent's most productive area.
6. It is a route which, with its up to the present meagre facilities, has successfully held its own with the Buffalo-New York route.
7. It is the eastern terminus of the St. Lawrence Canal System, giving 14 feet navigation from Montreal to Port Colborne. From Port Colborne the depth is 20 feet to Buffalo, Cleveland, Detroit, Chicago, Sault Ste. Marie, Fort William, and Duluth, a total distance of 1,400 miles.
8. Montreal is the railway centre of Canada. Trunk lines extend in every direction, and three trans-continental lines reach ocean navigation in the harbour.
9. Physically, Montreal is favourable for the construction of a port.
10. The water is free from sediment, and constant dredging is not required.
11. The whole of the water front and river bed is controlled by the Port Authority.

12. The Harbour is in the heart of the business section of the city.

13. The railway connections with the docks are the best on the continent.

14. The great transportation companies of Canada, both rail and water, have their headquarters in Montreal.

15. The trade by the St. Lawrence to Montreal is now nearly 30 per cent of the total commerce of Canada, including the trade with the United States.

16. The present situation of Montreal as regards the port, is as follows:—

Vessels per Annum.	Inwards and Outwards combined.	
	Number.	Tonnage.
Sea-going.....	2,400	5,000,000
Inland.....	25,000	6,000,000

The capital expenditure on the port to date is approximately the amount of the bonded debt, viz., $10,000,000.

The depth of water in the harbour and its approach is 30 feet at lowest water, or 31 feet 10 inches at the lowest stage reached in 1907.

The total shed area is 20 acres, to be doubled in 1909.

There are no tonnage dues on vessels.

The revenues are chiefly derived from wharfage rates on the goods and rentals of space.

Pilotage to the port is compulsory, and controlled by the Government of Canada.

The Port Authority is a Commission composed of three members appointed by the Government of Canada, subject to the approval, in the matters of expenditure, to the Minister of Marine and Fisheries.

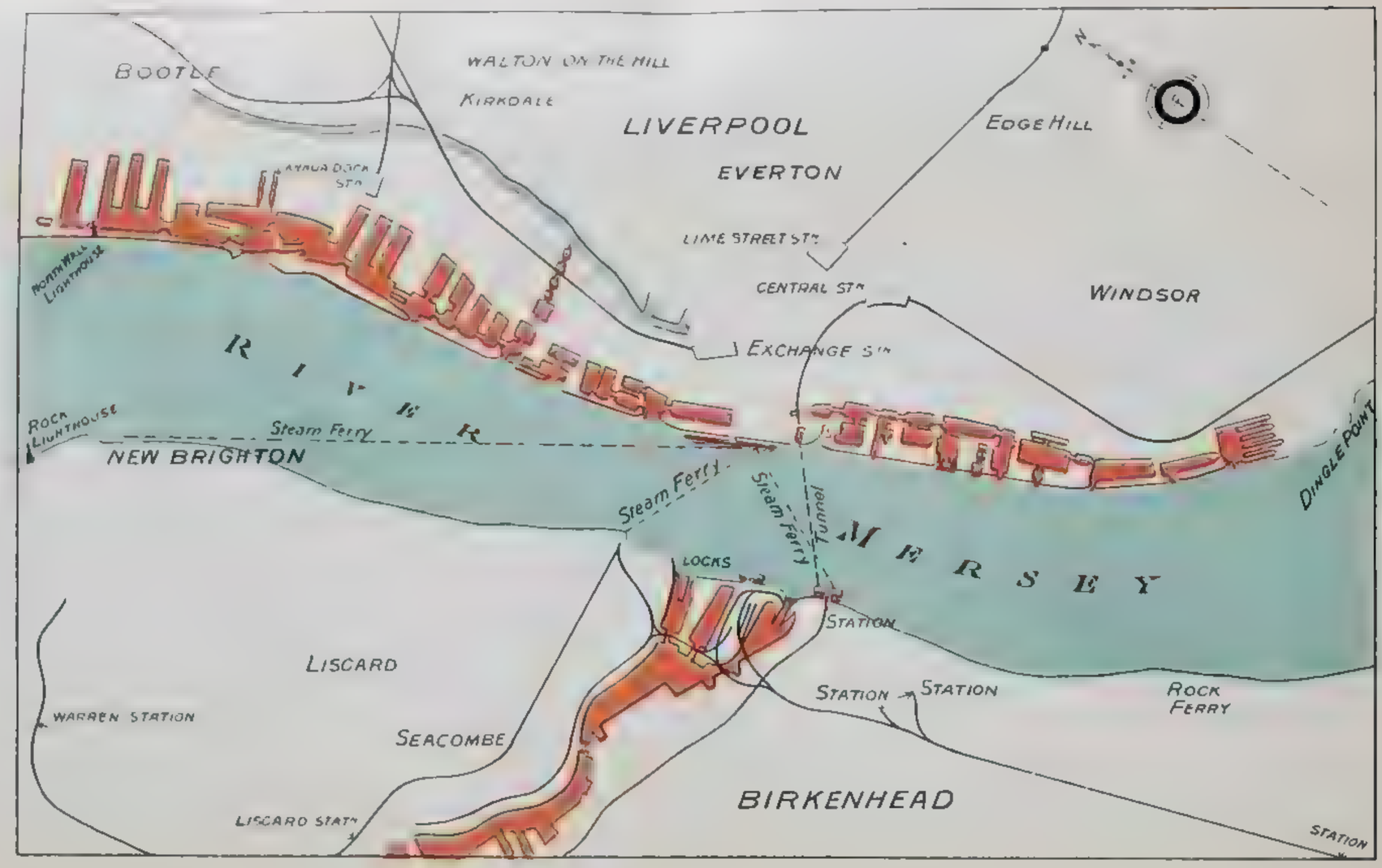
Conclusions.

Reference need only be made to the description of the eleven principal ports of Great Britain and Europe, in these pages, and a comparison with the physical, natural, and trade advantages of Montreal, to complete the favourable decision regarding the future of the Port of Montreal, and of the necessity of taking immediate steps in a careful and comprehensive way of development for the future.

The following sketches give an approximate idea of the extent of dock and shipping accommodation in some of the important ports, as compared with the Harbour of Montreal.

PORT OF LIVERPOOL.

FROM ROCK LIGHTHOUSE TO DINGLE POINT.



Scale

Statute Miles

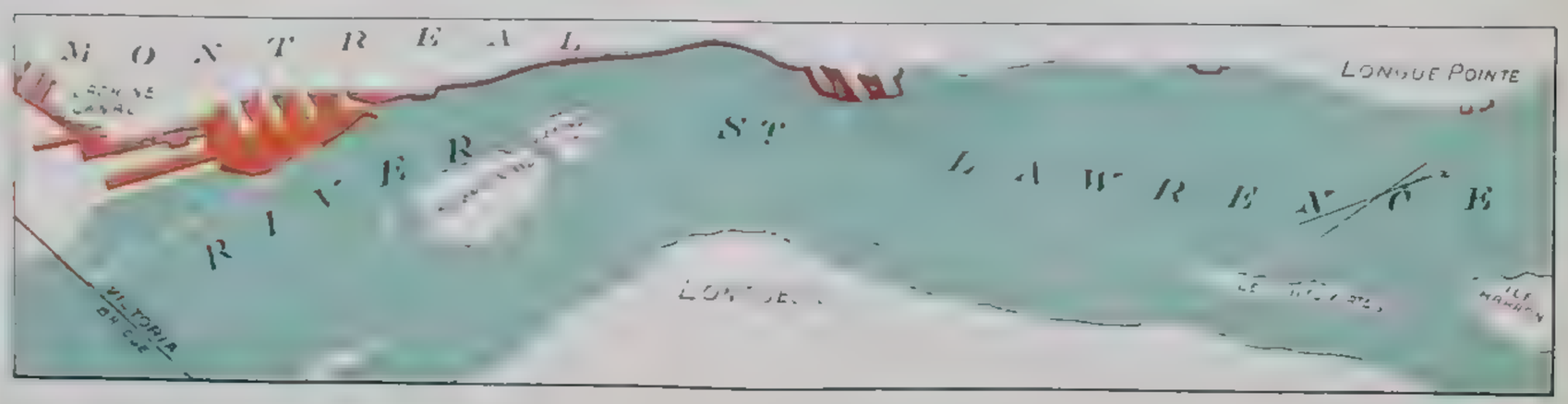
PORT OF MONTREAL

FROM

VICTORIA BRIDGE TO LONGUE POINTE.

Quays & protected basins in Red.

1907.



PORT OF LONDON

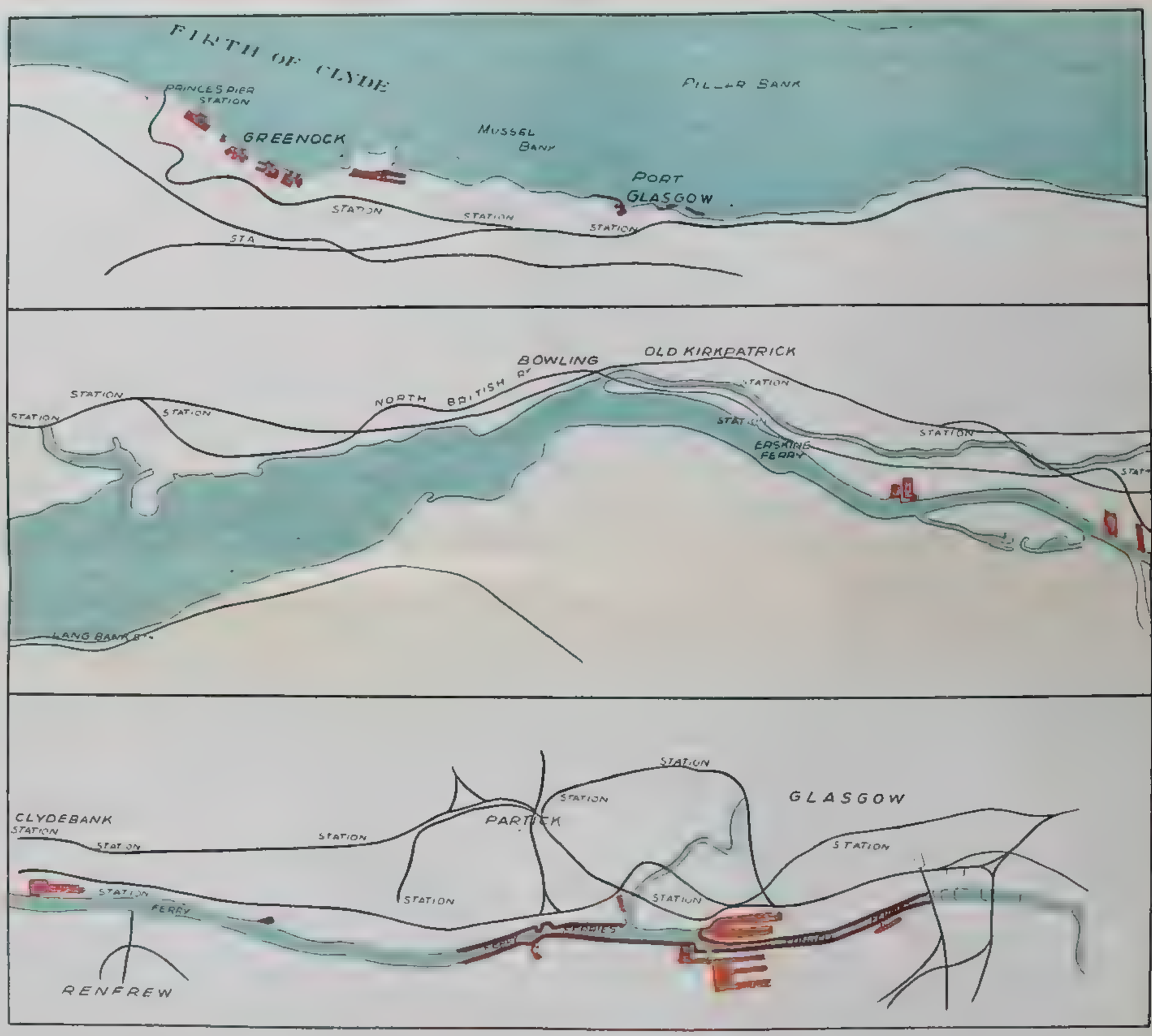
FROM LONDON BRIDGE TO GRAVESEND.

1907.

Port of Glasgow

PORT OF GLASGOW

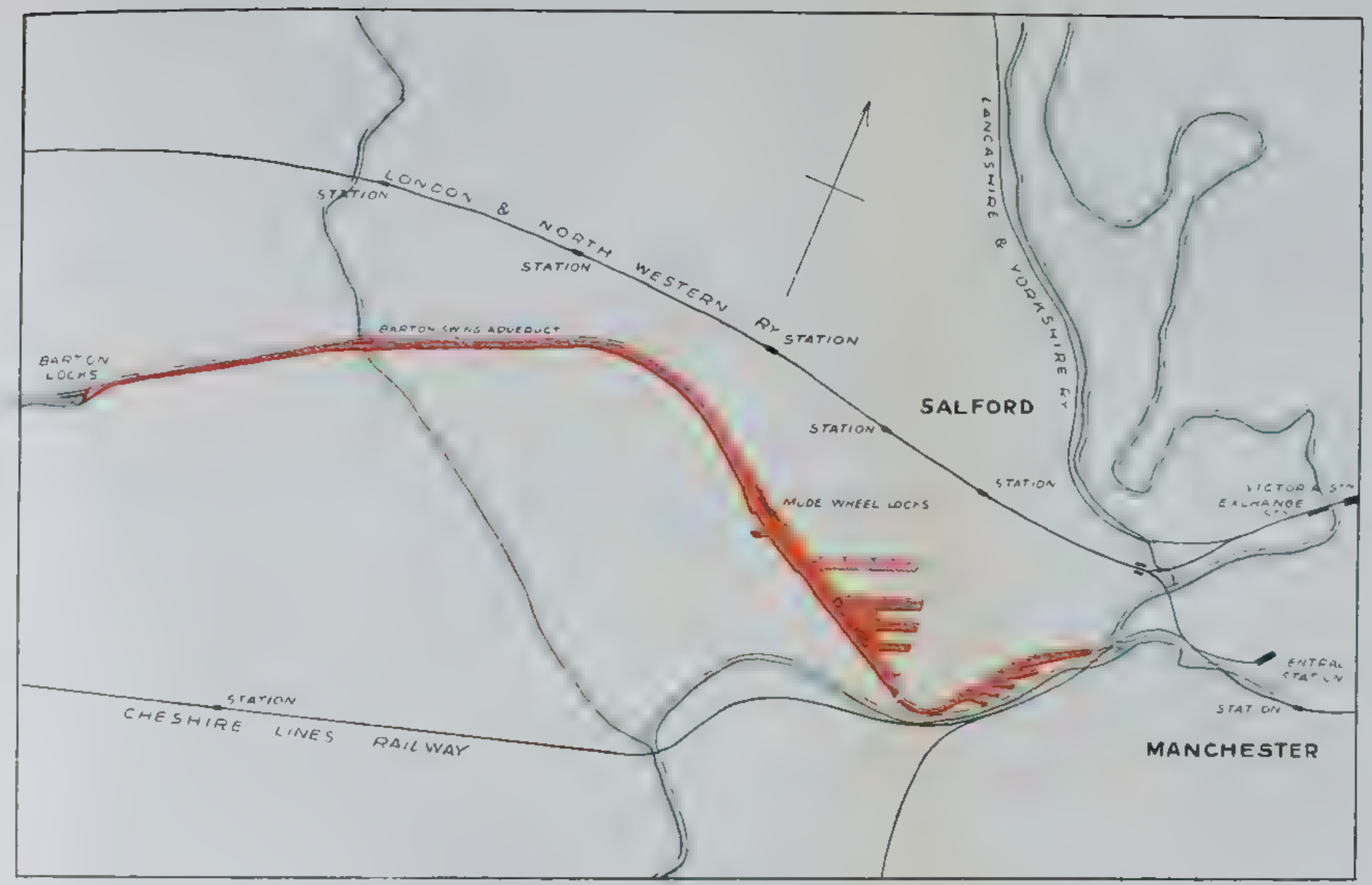
FROM GREENOCK TO GLASGOW



Scale


BARTON
LOCKS
STATION
CHESHIRE

MANCHESTER DOCKS.



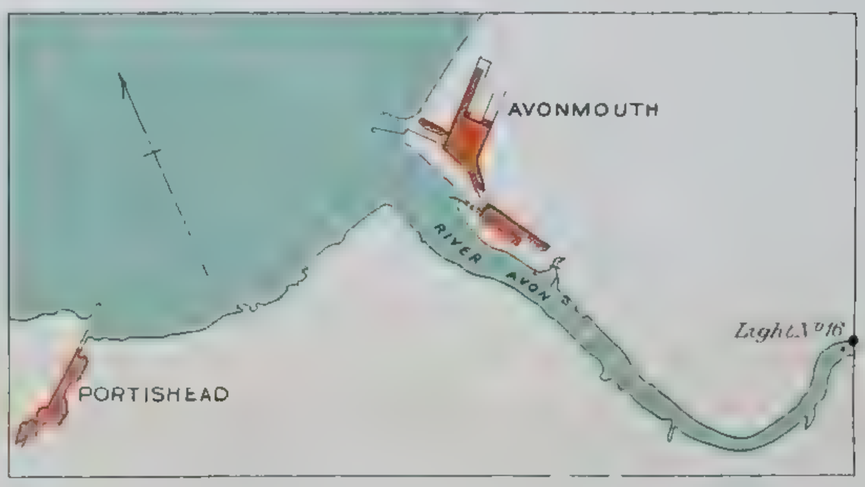
Scale

Vertical Miles

PORT OF BRISTOL.

PORT OF BRISTOL.

1907.



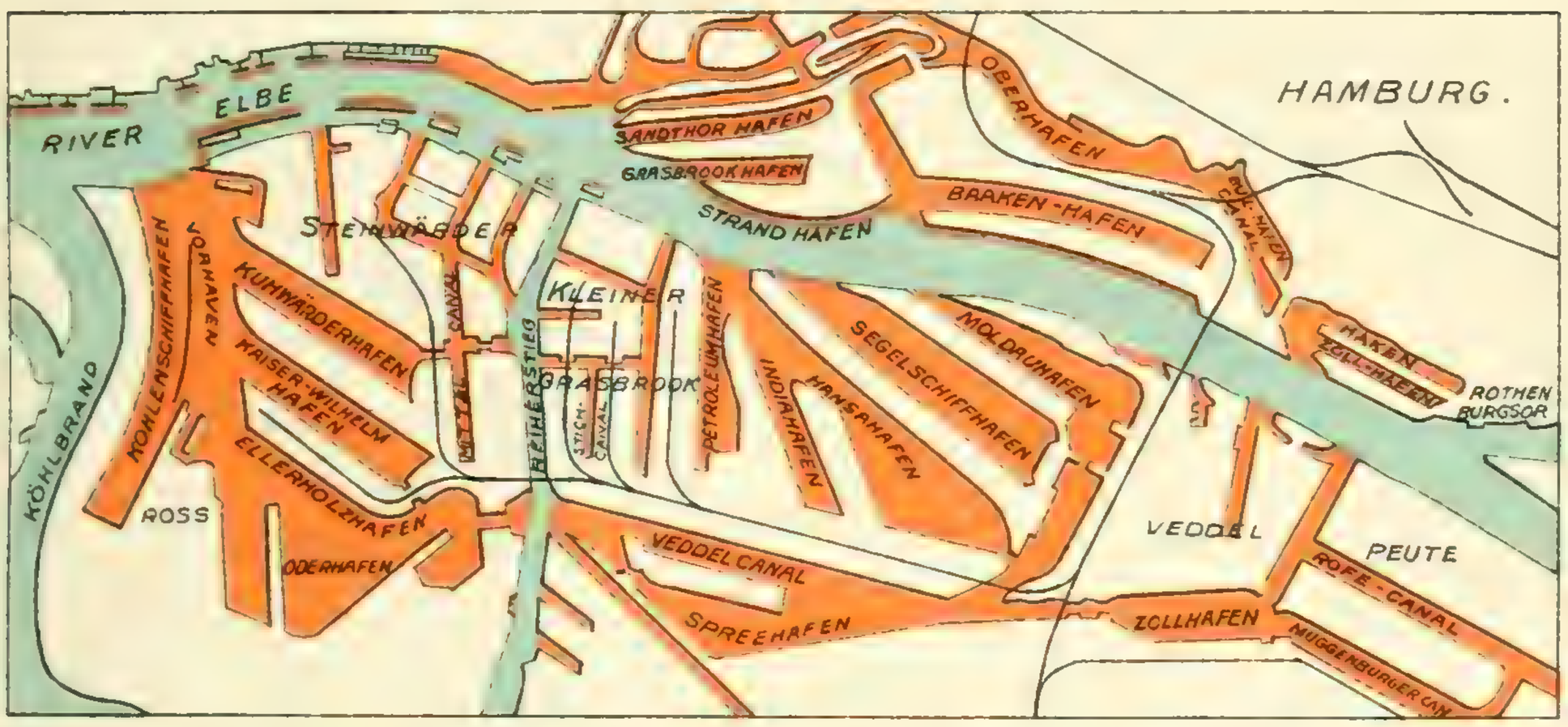
PORT OF CARDIFF.

BUTE DOCKS.

1907.

Scale

PORT OF HAMBURG.



Scale

Cables 10 5 0 1 2 3 Nautical Miles.

THE PORT OF ANTWERP.

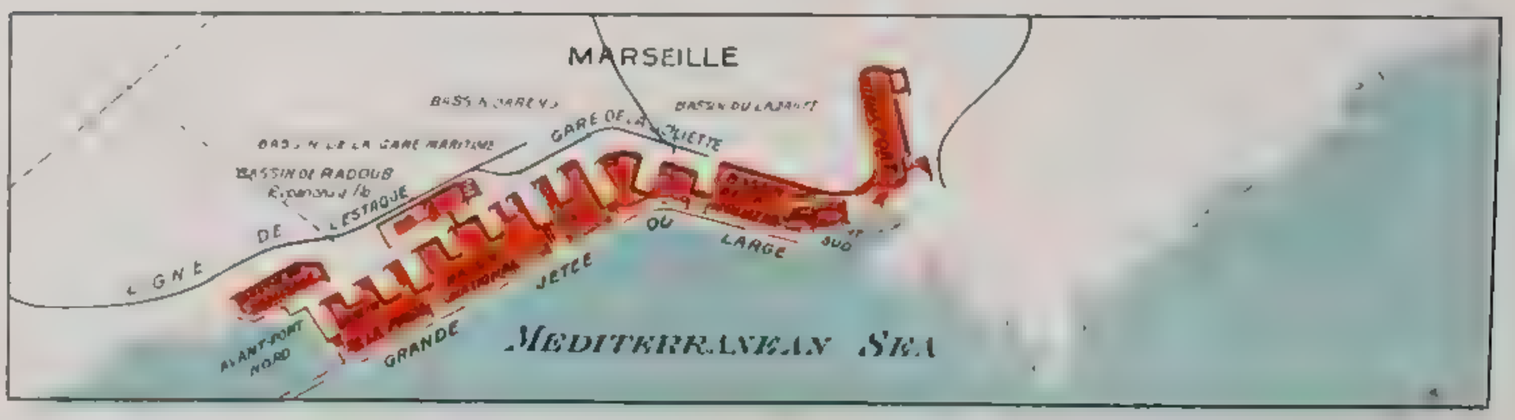
AUTHORIZED EXTENSION & PROPOSED DIVERSION OF RIVER,

1907.

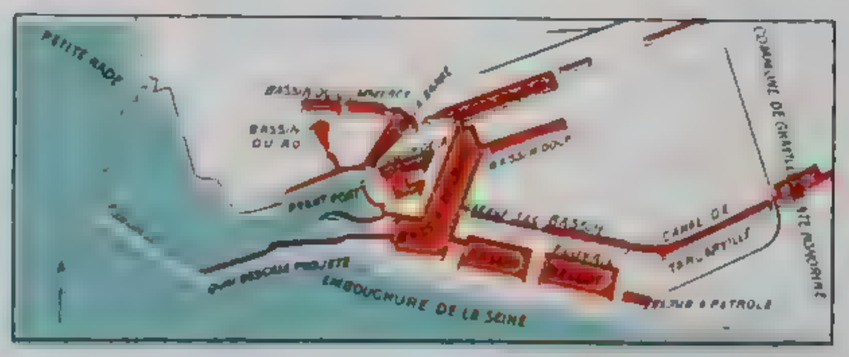
Scale

PORT OF MARSEILLE.

FRANCE.



PORT OF HAVRE.



TO ACCOMPANY REPORT TO THE MINISTER OF MARINE AND FISHERIES

OF CANADA

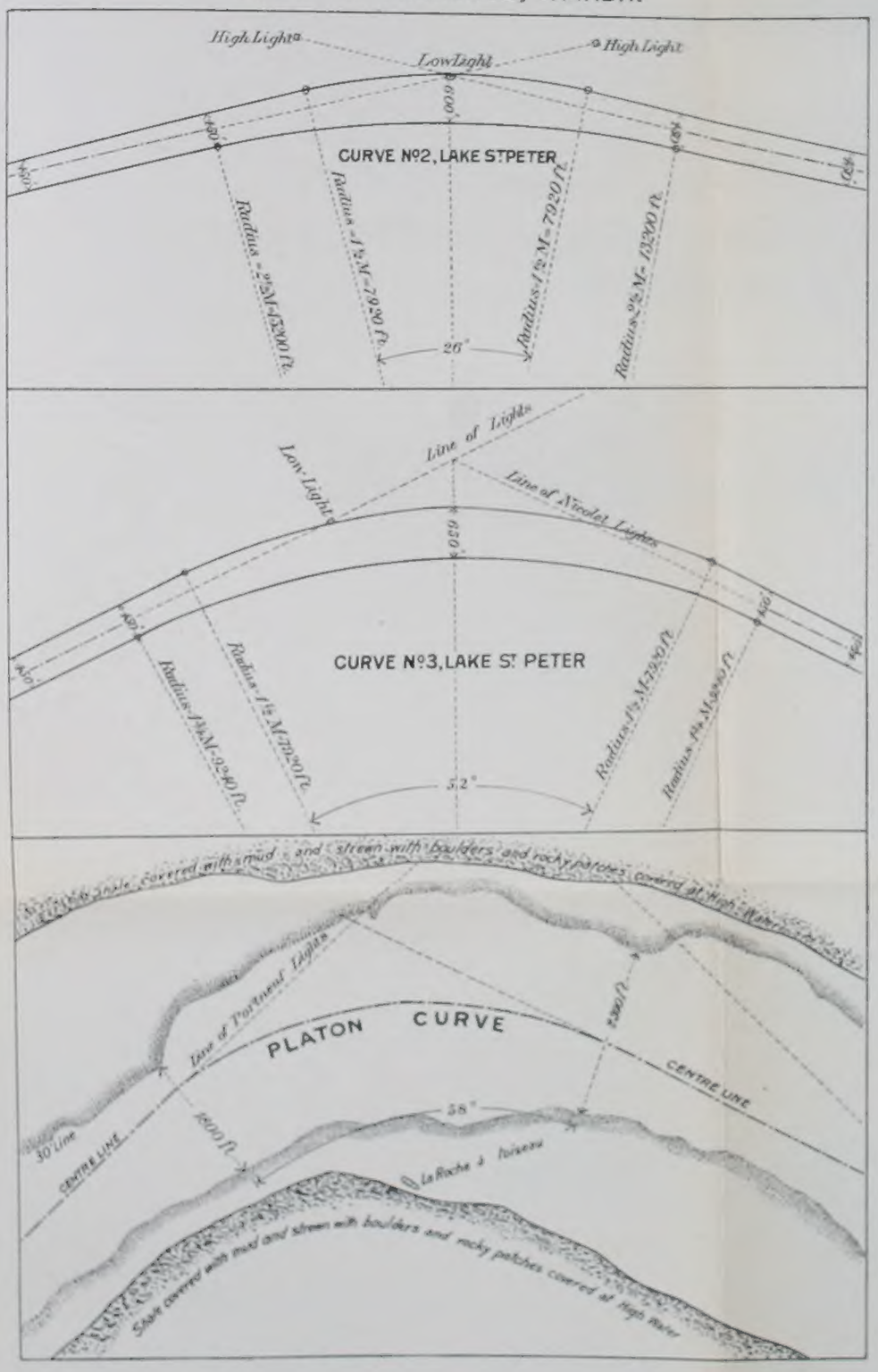
ON

BRITISH AND CONTINENTAL PORTS

1908.

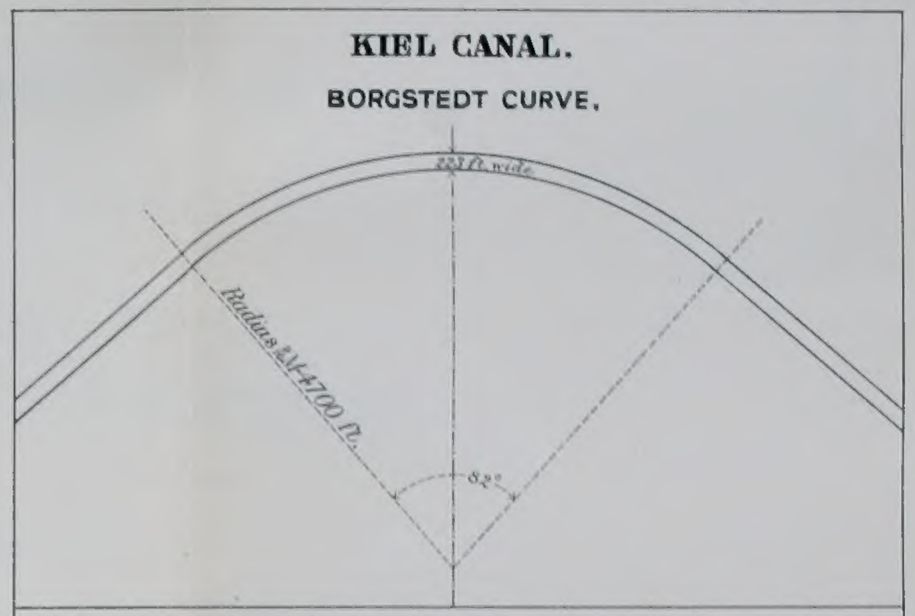
COMPARATIVE CURVES OF IMPORTANT RIVER CHANNELS AND CANALS.

RIVER St LAWRENCE, CANADA.



KIEL CANAL.

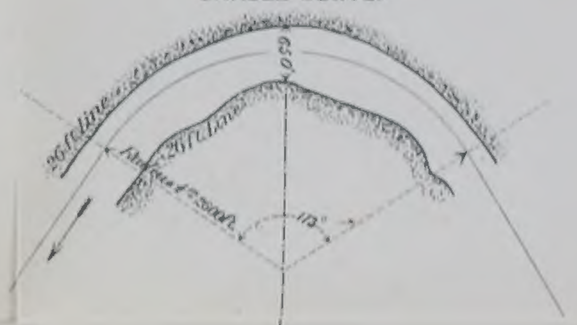
BORGSTEDT CURVE.



APPROACH TO ANTWERP HARBOUR

RIVER SCHELDT.

CITADEL CURVE.

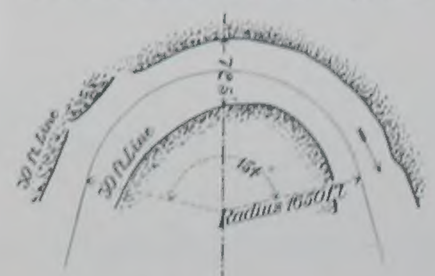


PORT OF LONDON.

RIVER THAMES.

BLACKWALL CURVE,

6 MILES BELOW LONDON BRIDGE.



Scale

0 2000 4000 6000 ft.

2000 ft. to an Inch

1 Nautical Mile

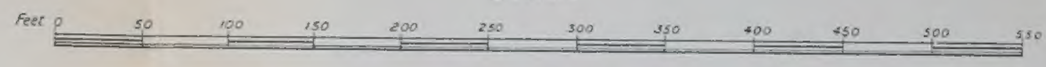
[N

TO ACCOMPANY REPORT TO THE MINISTER OF MARINE AND FISHERIES

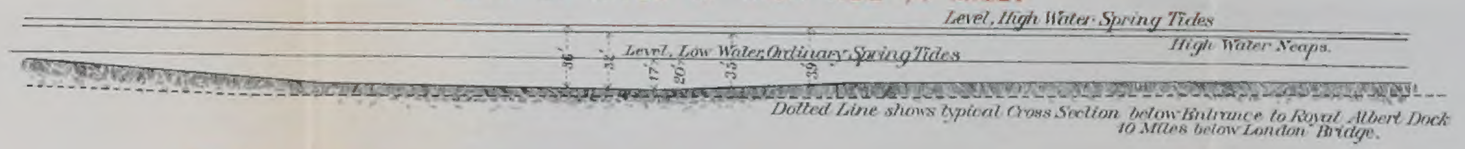
OF CANADA
ON
BRITISH AND CONTINENTAL PORTS
1908.

COMPARATIVE CROSS SECTIONS OF IMPORTANT RIVER CHANNELS AND CANALS.

SCALE.

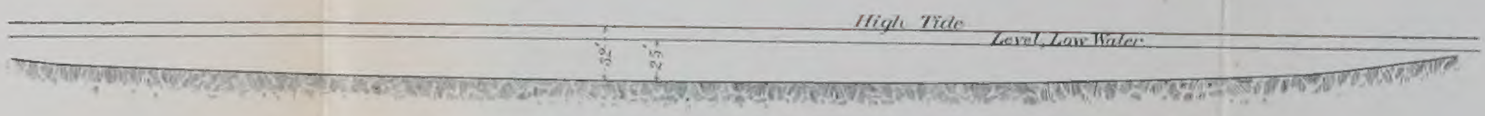


RIVER THAMES AT BLACKWALL, 6 MILES BELOW LONDON BRIDGE.
WIDTH OF RIVER AT HIGH TIDE 1/4 MILE.



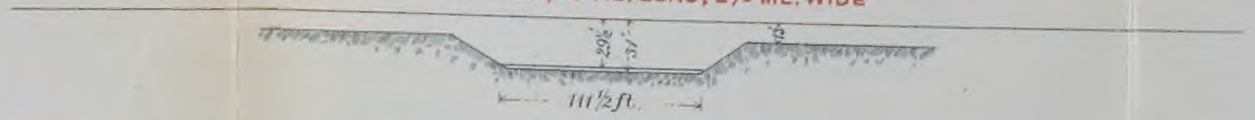
RIVER SCHELDT, DREDGED CHANNEL, BATH, 19 MILES BELOW ANTWERP.

RIVER ELBE, CHANNEL NEAR WEDEL, ABOUT 10 MILES BELOW HAMBURG.



KAISER WILHELM CANAL (KIEL CANAL) NORTH SEA TO BALTIC
STRAIGHTENING AND WIDENING AUTHORIZED AT ESTIMATED COST OF NEARLY $ 50.000.000.

SUEZ CANAL. CROSS SECTION THROUGH PETIT LAC AMER.
PETIT LAC AMER, 10 ML. LONG, 2½ ML. WIDE



RIVER ST. LAWRENCE SHIP CHANNEL THROUGH LAKE ST. PETER, 60 MILES BELOW MONTREAL.
LAKE ST PETER 25 ML. LONG, 9 ML. WIDE.
CHANNEL DOES NOT FILL UP